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**THE IMPACT OF AGRICULTURAL DEVELOPMENT PLANS ON THE
AGRICULTURAL LAND SETTLEMENT AT
THE JEFARA PLAIN, NORTHWEST LIBYA.**

YOUSEF OTMAN GWAZIE

A thesis submitted in partial fulfillment
of the requirements of the
University of Northumbria at Newcastle
for the degree of
Doctor of Philosophy

Research undertaken in the Newcastle Business School

November 2004

ABSTRACT

This research is based on a critical examination and evaluation of the Jefara agricultural land settlement project in the north west of Libya, which was initiated in the mid-1970s. Following the Socialist Revolution in September 1969, Libya became an isolated and closed economy. The promotion of agriculture and industry became the main priority for self-sufficiency and a survival strategy. In particular, the development of agriculture had to be vigorously pursued through subsidies to needy farmers, vast injections of social overhead capital, and, of course, land reclamation and agricultural settlement.

In its evaluation of the Jefara land settlement project, this study adopts both theoretical and applied approaches. On the theoretical side, the study lends itself to two different strands: (i) the cost-benefit analysis approach, identifying and measuring the shadow prices leading to estimates of the total willingness to pay for a given service/good; and (ii) the theory of growth and development. On the empirical side of the analysis, primary information is obtained from a questionnaire completed by farmers, providing the appropriate tools of analysis, and the means to compare and contrast the farmers' views with official statistics.

The research concludes that in terms of social welfare, the land settlement project has been relatively successful in creating and settling new citizens. However, it is concluded that such settlement projects have primarily failed to operate as efficient economic units, since scarce resources have been misallocated and mismanaged.

ACKNOWLEDGMENTS

I have had the great pleasure of receiving guidance from two supervisors, Dr.Majid Taghavi and Mr. Snowdon, whose comments have much improved the quality of my research. I thank them both for the advice and encouragement received at various stages of my research. I would also like to express my gratitude to the Research and Support Office at Newcastle Business School.

Lastly, I would like to thank my family for the inspiration and support they have given me pursuing my studies.

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DECLARATION

I certify that this work has not been accepted in substance for any degree and is not concurrently submitted for any degree other than that of Doctor of Philosophy of the university of Northumbria. I also declare that this work is the result of my own investigation except where otherwise stated.

Signature of Student:

DEDICATION

To My Parents

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ABBREVIATIONS

AAR	Agriculture and Agrarian Reform
CAD	Council of Agriculture Development
CBA	Cost-Benefit Analysis.
CN	Condition Number.
CV	Coefficient of Variation.
GDP	Gross Domestic Product.
GNP	Gross National Product.
IAR	Integrated Agricultural Reform
IMF	International Monetary Fund.
LARC	Libyan American Reconstruction Commission.
LATAS	Libyan American Technical Services.
LD	Libyan Dinar.
LDC	Less Developed Country
LPDSA	Libyan Public Development and Stabilization Agency.
NID	Normally Independently Distributed
NPV	Net Present Values.
OEA	Tripoli, Sabratha, Leptis Magna.
OLS	Ordinary Least Squares.
SER	Standard Error of Regression.
UNTAM	United Nations Technical Assistance Mission.
USOM	United States Operation Mission.
VIF	Variance Inflation Factor.
WLS	Weighted Least Squares.

CHAPTER ONE

INTRODUCTION AND THE PURPOSE OF THE STUDY

1.1 Introduction

The first of September 1969 revolution in Libya adopted socialist principles in implementing its economic development plans. Socialism in Libya has been, however, inspired by the Islamic and Arabic heritage through the application of social justice. It had been assumed that the system would forbid any kind of exploitation and seek to achieve self-sufficiency in production in order to liberate the national economy from dependency on foreign influence, and to secure equality of distribution among all classes in a peaceful way. The revolution gave due attention and priority to the agricultural sector, through agrarian reform and integrated agricultural development.

The agricultural policy in Libya implemented in the 1970s and 1980s aimed at realizing a so-called "Green Revolution" by transforming the traditional subsistence type of agriculture, which had prevailed in the past, into a mechanized, commercial and modern agriculture. To attain this objective, the revolution committee exerted great effort and allocated huge financial resources in the promotion of this supposedly vital and important sector of the national economy.

The main task of the Council for Agricultural Development was to reclaim and develop new arable lands for the implementation of the integrated agricultural

programmes. These programmes comprised of the following projects:

- The creation of new agricultural settlements in various parts of the country.
- The revival and development of the abandoned and neglected former Italian demographic settlements.
- The reclamation and development of new arable lands for the creation of public projects such as the cultivation of cereals (mainly wheat and barley), the cultivation of fodder crops for sheep and cattle raising, and the planting of tree crops for fruits production, and the forestation of new lands in mainly sand dune areas.
- The resettling of nomads, semi-nomads and farmers from remote poor areas in new agricultural settlements, which were established in various parts of the country.

The mainstay of integrated agricultural development was the creation of agricultural settlements in the following five areas:

i. Jefara Plain Region. This project comprises of the Jefara Plain, the highlands and terraces of Jebal Tarabulus, and the Khoms Misrata area; all located in the north west of Libya.

ii. Jabal El Akhdar Region. This area Comprisies of Jabal Al Akhdar (Green Mountain), the Sahil Benghazi plain, the coastal strip of Marmarica (around Tubruk) and the Bulut area, south of the foothills of Jabal Al Akhdar. This region is in the east of the country and includes the city of Benghazi.

iii. Kufra and Es-Sarir Region. This area comprises the Kufra agricultural project area, 3 km south east of El Jowf, the central oasis, the Sarir agricultural project area, Jalo-awjla oasis and Marada Oasis.

iv. Fazzan Region. This area comprises Sabha, Wadi Ash-Shati, Wadi El Amal (formerly Wadi El Ajal), Tahala, Erawin, Ubari Murzuk basin and the Wadi El Ghatroon area.

v. Es-Sulul El Khudur Region. This area comprises several Wadi beds in the southern slopes of Jabal Tarabulus and south of Sirt.

The total area designated for the integrated agricultural development programme in the aforementioned regions during the period 1976-80 was estimated at just over one million hectares.

Agriculture development planning, dealt with in this research as an identical asset, is formulated as an integral part of an overall development programme within the economic and social development plans.

This research therefore analyzes the evolution of agricultural development planning in Libya since early times up to the present day paying special attention to one of the largest agricultural transformation plans of 1973-1985 in the Jefara plain in northwest Libya.

1.2 Aims of the Study

This research is primarily based on an examination and economic evaluation of a land settlement project in the Jefara plain with the following aims:

1. To assess the effectiveness of land utilization in the above-mentioned projects.
2. To examine the real socio-economic impact of the programme on the farmers involved and the nation.

3. To evaluate the incentives for increasing agricultural production and productivity, and in achieving self-sufficiency in food production.
4. To assess the real costs and benefits of the programme and to draw policy recommendations.

1.3 Theoretical and Methodological Issues

The economic theory applied here lends itself to both microeconomics and macroeconomics. On the microeconomic side, the thesis is based on the cost-benefit approach, aiming to examine the overall tangible and intangible costs and benefits of the project over the period of the study. In so doing, the concepts of *willingness to pay* and *shadow prices* are considered and examined using a questionnaire. The questionnaire is therefore designed to capture information about the farmers' willingness to pay in measuring additional costs or benefits accrued from the land settlement project.

On the macroeconomic side, the research lends itself to the theory of growth and economic development. In this respect, the research examines contributions made by economists over 200 years in the areas of agricultural, industrial and organizational development.

On the methodological side of the analysis, the collection and examination of secondary data, as well as information obtained from a questionnaire completed by the farmers, allows the farmers' views to be compared and contrasted with the official statistics. A questionnaire distributed to well over 1000 farmers yielded just over 500 respondents. The questionnaire, which was designed and conducted in 2002, captures

information on socio-economic aspects of farmers settled in the Jefara Plain. Finally, the official data were, in the main, compiled by the Ministries of Agriculture, Reclamation and Land Reforms; Agriculture; Planning; and latterly by the Committee of Agriculture.

Using a simple cross section regression analysis, the extent of contributions made by both social and economic factors in the success/failure of the project over the period of the study are estimated. In effect, in support of theory, the marginal contributions made by each and every deterministic factor in the overall performance of the settlement project is investigated

1.4 Structure of the Thesis

This thesis consists of six chapters and three appendices. Chapter Two considers a historical examination of agricultural development projects in Libya since the time of the Phoenicians. A large part of this chapter is dedicated to a description of the post-revolutionary period, making special reference to the land settlement project at Jefara Plain to the North West of Tripoli.

Chapter Three examines and reviews the theoretical contributions made over the past two centuries in the areas of economic development and growth. In particular, this chapter identifies aspects of such theories in relation to agricultural development in the developing economies. In addition to the classical and neo-classical approaches to development, so-called endogenous growth theory is also considered, where social and political infrastructures have been identified as major sources of success or failure in any economic development.

Chapter Four, on the other hand considers the cost-benefit analysis of a social project in examining and evaluating the microeconomic foundations upon which the theory is based. In particular, the aspects of time preference and shadow pricing in practice are highlighted in this chapter, aiming to apply these concepts to data from the questionnaire. The findings from the use of this technique allow the formulation of some limited policy implications in relation to the extent of the failure or success of the project.

Chapter Five examines the statistical characteristics of the data and develops and estimates an econometric model of land use on the basis of the data collected from the questionnaire. The aim here is to estimate the marginal contributions made by each explanatory variable in the model using a simple linear/log-linear model

Chapter Six finally draws the overall conclusions of the thesis by making references to some specific findings/recommendations derived from this research. In addition, this chapter outlines the main contributions and limitations of the research, and hence identifies avenues for future research which arise from this investigation.

CHAPTER TWO

AGRICULTURAL DEVELOPMENT PLANNING IN LIBYA: A HISTORICAL OVERVIEW

2.1. Introduction:

Libya as a whole has been since time immemorial a poor country. Traditionally the inhabitants have been primarily pastorals rather than cultivators. This was due to the physical drawbacks of the arid soils and the uncertainty of rainfall, as well as social tradition. Settled farming of subsistence type existed only in very few and dispersed areas, mainly on the coastal strip and depending on the subsoil water (7-10m deep) for irrigation.

Nowadays, this water has depleted, and sea water intrusion has replaced the fresh water. Hence, most of these areas have turned to urban usage. Agricultural development in the area under consideration has followed a historical sequence described below:

2.1.1. The Phoenician period:

The Phoenicians came to the Tripoli coast in about the 6th century B.C. as traders; they used to exchange merchandise with ancient Libyans. Then they gradually established exchanging stations on the Tripolitanian coast and finally settled permanently in those areas. Gradually, they established the three cities of the (OEA) Tripoli, Sabratha, and Leptis Magna. However, Leptis Magna was chosen as the capital city of the Phoenicians in Libya by the year 517 B.C ⁽¹⁾. In their settlements, on the Tripoli coast, the Phoenician economy was dependent on two main sources:

1. Trading in goods that were brought to these cities from central African countries by caravan merchants.
2. Being very skilled farmers as well as good traders.

The Phoenician farmers engaged in various agricultural activities, mostly practicing intensive farming in patterns of agriculture suitable for those areas. The land use patterns were mainly based on the farming of olive trees for their valuable returns. The coastal strip soils and the prevailing climatic conditions were especially suitable for the growing of olive trees.

In their farming the Phoenicians used modern systems in dealing with olive trees. They also introduced to the area under consideration different kinds of fruit trees which were unknown before, such as fig trees, pomegranates, beeches almonds, and vineyards.

The so- called "lotas" comes from essidr trees, which are semi-desert thorny trees. These were regarded as interesting fruit by Heradouts, who visited Libya in the 5th century B.C. and named the ancient Libyans as "Loti Faggi"⁽²⁾.

The Phoenicians also engaged in farming grains such as wheat and barley, and for this they were interested in collecting rainwater in large cisterns for irrigation. This project, however, was fully accomplished by the arrival of the Romans, who took over, the whole of Libya from both the Phoenicians in Tripolitania and the Greeks in Cyrenaica.

2.1.2. The Roman Period

Agricultural activities in the Tripoli region during the Roman occupation included the farming of olive trees and crop production. Olive oil and wheat production was mainly export to Rome, so that Libya became known to the Romans as ‘The Granary of Rome’.

The cultivation of olive trees during the Roman period occupied large areas of the Tripoli region extending from Tarhuna Mountain eastwards through Misallata, to Al-Khoms, and from Tarhuna in the south to the coastal strip in the north. In other words, the olive trees occupied almost the entire eastern Jefara region up till En-Naggazah, west of the Al Khoms area. The number of trees in this area was estimated at about three million. This assessment can be deduced from the inscript imposed by the emperor Septimius Severus against the people of Leptis Magna. This fine was estimated to be one million liters of olive oil. However, it required about one million olive trees to produce such a quantity of oil ⁽³⁾.

For the safety of the transport of oil from the interior to the sea port of Leptis Magna, the Romans constructed a pottery canal extending from Misallata in the mountains down to the coast, at Leptis Magna harbour. In order to ease the hauling of the oil, it was stored in large cisterns. Consequently, it filled huge gullets which were shipped on vessels for shipping to Rome. However, the remnants of the pottery canal still exist in several sites standing as witness to the glorious agricultural past.

The Roman financial capitalists encouraged the cultivation of the olive trees in Libya for their high returns. Because of this encouragement, olive tree plantations were widespread over almost the whole area under consideration, especially in the areas of

OEA (Tripoli) and Sabratha. The success of tree cultivation was initiated at the beginning of the second century B.C.⁽⁴⁾ In addition to this agricultural activity, there also existed traditional farms. These farms were characterized by integrated agriculture.

2.1.3. The Vandal period

The Vandals had no economic interest or any strategies for the occupied region of Tripolitania. However, in spite of their occupation of Tripolis and islands in the Mediterranean Sea and Italy, their occupation of these areas was indirect. The Vandals did not leave any inherited traces, ruins or tools, except some coins, which were found in Leptis Magna market in Tripolitania.

The spread of vandalism in these period turned inhabitants adopted a tribal system, leading them to steal loot and kill in pursuit of tribal survival. This led to the devastation of large areas of cultivable land, which had originally been reclaimed by the Romans. As a consequence, the terrain became decertified and arid.

Following battles between 527 and 533 AD, the local tribes with the support of the Byzantians, managed to overthrow the Vandals and their oppressive rule from the region.

2.1.4. The Byzantine Period:

After the collapse of the Vandal domain in North Africa, as a consequence, the Byzantines succeeded beginning in the year 534 A.D. The Byzantines ruled the

Tripoli region and elsewhere in Libya without paying any attention to agricultural activities. All their interest was concentrated on the collection of taxes. (Al-Barghuti)

Despite the administrative reforms carried out by the Byzantines, and the survival of the Christianity faith, particularly of Catholicism, the Byzantine's civilization had no deep roots in Libya as a whole. They did not absolutely pay any care to the agricultural development, except the taxes, which, they had repined. The general outlook of Byzantines was an indication to the quick decline of the country to the standard of nomadic pastoralism.

The Byzantines facet of civilization collapsed quickly after the invasion of the army of Amr Ibn Ala'ass, the conqueror of Egypt. The Muslim army invaded Cyrenaica and Tripolitania between the years, 642 and 643 A.D. None of Byzantine's cities showed much resistance against the newcomers, except feeble resistance carried out by the people of the city of OEA (Tripoli) ⁽⁵⁾.

2.1.5. The Arab Period:

After the defeat of the Byzantines in North Africa, the Arabs arrived in successive waves from Najd in Saudi Arabia during the seventh till the ninth century A.D. Although the Arabs ruled the country for about four centuries, and due to the nomadic nature of the Arab people, economic life in all the cities remained as it was before. However, the deterioration of the flourishing life remained to a certain extent, as it was during the last days of the Byzantines reign. In addition, the invasion of Libya by the Bani Hilal and Bani Sulaim tribes during the second half of the 11th century thrust a nomadic type of life, reflecting the loss of settled agriculture

throughout the country, and especially in the Tripoli region. Commerce and trade were also handicapped as a result of the new political and social traditions⁽⁶⁾.

After the Muslims had settled in Libya by the first century hijra (the 8th century A.D), the country had restored its lost stability, peace, and reassurance. Thus agricultural development in the Tripoli region flourished again, and farms were widespread in the rural and urban areas. And their production of crops profuse, the good delicious fruits, which were incomparable with any other fruits else where such as, apricots and peaches.

The most important agricultural products during the Arab period were olive oil, honey, and other fruits such as peaches, apricots, figs, pears, dates and grapes. The farmers also cultivated grains such as wheat and barley. Farming patterns used intensive cultivation and the farmers also poultry birds and cattle animals⁽⁷⁾.

2.1.6. The Ottoman Period 1551-1911

Turkish rule in Libya lasted for nearly four centuries, during which time nothing was done to promote agricultural activities. However, in the later years of the Turkish rule in Libya some efforts were made in land development. The Ottoman Land Code was implemented in order to impose more taxation on agricultural lands. Some water wells were also dug for drinking purposes, mainly in the urban areas.

2.1.7. The Italian Colonization 1911-1943.

Before the Italian occupation in 1911, there was no agricultural planning as such in the modern sense. The first agricultural development plan was launched by the Italians in Libya in 1914. The impact of Italian colonization on agricultural land use began on a small scale, as confiscated lands were granted to private companies and individual enterprises for development. As more land was confiscated, development and settlement gradually increased in intensity reaching a climax between 1938 and 1942, when large numbers of colonists arrived in Libya. By then the number of Italians had reached about 110,000 persons⁽⁸⁾.

During their occupation of Libya between 1911 and 1943, the Italians spent over 50 million Libyan dinars (LD.) on public works and utilities and agricultural development.⁽⁹⁾ The allocations for agricultural development were mostly spent on land reclamation and agricultural settlements.

Unfortunately, this intensive agricultural development and the demographic settlements were primarily designed for the benefits of Italian colonists, while Libyan agriculture and welfare were largely neglected.⁽¹⁰⁾

It is worth mentioning, however, that a few Arab demographic settlements were designed to be part of the system, but hardly any progress was made in these settlements, and no Libyans occupied them until the Italians were expelled from Jabal Al-Akhdar in 1942 and from Tripoli Tania in 1943.

2.1.8. The British-French Military Administration 1943-1951.

The British and French Military Administration period lasted from 1943 to 1951, and came after bitter fighting between the Allies and Italy and Germany in North Africa. Libya, however, was the critical battleground in North Africa. Consequently, in addition to the destruction of cities, towns, villages and roads, World War Two devastated agricultural land, animal wealth and farm labour, especially in eastern Libya.

The preoccupation with the political future of Libya kept economic planning or agricultural development off the agenda for the British and the French authorities. The British Military Administration in Libya lacked financial resources, and consequently offered very little, if any, economic progress.⁽¹¹⁾ Nonetheless, the British authority, with a deficit in public budget, paid more attention to the maintenance, repair, and reconstruction of the devastation from the war, than agricultural development.

The stagnation and backwardness of Libyan agriculture after World War Two was aggravated by the successive droughts of 1947-48, causing the total loss of agricultural production and animal death on a massive scale. It is worth mentioning that the British Military Administration did make some contribution to agricultural development in the Jabal Al-Akhdar area, where the former Italian estates at El Gubba and El Marj Plain were reinvigorated and brought under intensive crop farming. The El Marj Plain was used particularly for the production to provide the Middle East Supply Centre with its needs in wheat.⁽¹²⁾

Nothing was done by the French authority in the Fazzan area concerning agricultural development, except for the drilling of a few wells for irrigation and drinking water in some of the oases such as Ghadames, Daraj, and Wadi Ash-Shati.

2.2. Agricultural Development Plans 1952-1969

As already discussed, the agricultural sector, prior to the independence in 1951, absorbed about 80% of the labor force in the country and 95% of domestic exports came from agricultural and animal products. After independence, the agricultural situation remained almost the same. Libya then received massive international aid, partially in return for the use of military bases by Great Britain, France and the United States. The rest of the aid came as grants from the United Nations and friendly countries such as Egypt, Italy, and Pakistan). The continuation of foreign aid was vital for the containment of further economic decline. In these unhappy circumstances, the United Nations accepted full responsibility for assisting Libya to achieve a higher standard of living through the design and implementation of an overall economic development plan.⁽¹³⁾

Even after the discovery of oil, in 1956, agriculture was still regarded as the cornerstone of the Libyan economy, until 1962 when crude oil was first exported. Thus, government policy towards agriculture was still very generous. Nevertheless, agriculture remained a stagnant and challenging problem. This was due, to several impediments, such as the damage to the soil through many centuries of misuse, the unreliability of rainfall, farm mismanagement, the lack of capital and the poor use of fertilizers in addition to the backwardness and almost complete illiteracy of the farmers.

It was in the midst of this challenging and complex situation that the first draft of the first agricultural development plan for Libya was designed by the United Nations.

2.2.1. The First Comprehensive Agricultural Development Plan 1952-1958

The first agricultural development plan was recommended to the Libyan government by the United Nations Mission which visited the country in 1951⁽¹⁴⁾. However, it was recommended also that the first six-year plan would be followed by a second, a third, a fourth and subsequent six-year plans, until the arable lands could be reclaimed and cultivated so that agricultural production would balance domestic demand, and if there was a surplus this would be exported to European markets.

As a consequence, in 1952 the Libyan government established the Libyan Public Development and Stabilization Agency (LPDSA) and the Libyan Finance Corporation. In addition to these Libyan agencies, the Libyan government affiliated to the Libyan-American Technical Services (LATAS) and the United Nations specialist agencies which together assumed full responsibility for the execution of the first plan. However, the first development plan was proposed at a time when the national budget had very limited financial resources. Thus, the development budget was based on the assumption of financial aid given by the United Nations and foreign governments.

The main target of this development plan was the improvement and restoration of the existing agricultural lands in order to make farming a more lucrative and beneficial investment, subsequently to improve the living conditions of the farmers. However,

the development of new agricultural areas was extremely limited. The main policy was to retain small-scale subsistence farming and extensive cereal growing and animal breeding as the basis of the Libyan economy. Thus, most of the budget allocated for agricultural development was in fact spent on long-term investment, such as in ground-water investigation, afforestation and dune fixation, flood control, service water reservation, and agricultural extension,⁽¹⁵⁾.

Generous and careful treatment of the Italian farming community in Tripolitania was encouraged in the plan wherever possible to keep the Italian farmers on their land. However, the Italian farms which were established in the late thirties reached their full production at the beginning of independence.

The Bedouins took over the estates and farms in the eastern part of Libya after the Italian eviction in 1942. However, due to their almost complete ignorance of settled farming most, if not all, of the farms were neglected, and the agricultural production of the ex-Italian farms in this part of the country had consequently declined considerably.

Due to the circumstances in Libya at that time, the first six-year development plan was never fully carried out. The budget for the plan was proposed at LD 30 million.

2.2.2. The Second Agricultural Development Plan, 1956-1961

Libyan-American cooperation in agricultural development increased after the Libyan-American friendship treaty was signed in 1955. As a consequence, the Libyan-American Reconstruction Commission (LARC) was established.

However, the LARC experts recognized that the first six-year plan was out of date; and hence a new programme for development was put forward in 1956⁽¹⁶⁾ by an international committee consisting of representatives from the Libyan government, the United States Operation Mission in Libya (USOM) and the United Nations Technical Assistance Mission (UNTAM) in Libya. The proposed new agricultural programme was designed to be executed as a second phase of the five-year development plan from 1956-1957 to 1961-1962.

The injection of foreign aid to Libya stimulated the import of many processed foods, vegetables and fruits in order to meet local demand, particularly by foreigners. It is worth mentioning here that, most of the designated budget for development was spent on administrative expenses and allowances for foreign experts, technicians and personnel. Libyan farmers were nominally assisted by being granted seeds, fertilizers and simple farming equipment. Although many independent projects were taken on by the LARC and the LPDSA, the second development plan, as such, was never carried out.

However, like many other sectors in the overall economic plan, the agricultural sector lacked coordination and cohesion. The actual total expenditure on the agriculture sectors reached LD.1.6 million or 80% of the total budget allocated for the economic development programmes of 1957-1961.⁽¹⁷⁾

2.2.3. The Third Agricultural Development Plan, 1963-1969

This agricultural development plan was to be considered the first plan ever put into effect and carried out along with the general economic plan. The main objectives of

this agricultural development plan were to promote price stabilization, improved agricultural production, and improved for living standards farmers through the allocation of funds and training schemes.

However, prior to the discovery and export of crude oil, agriculture was still the largest single contributor to GDP. For example, in 1958 agricultural output contributed about LD 13.6 million or 26.1% of the total gross domestic product. Ten years later, the share of agriculture output decreased to about 2% while oil returns jumped to over 92% (LD 950 millions) of GDP. Table 2.1 shows clearly that agricultural output decreased in inverse proportion to the increase of petroleum's share of GDP.

The immediate economic impact of this oil exploration was the injection of substantial money supplies in the big urban centres (i.e. Tripoli and Benghazi), as the oil revenues rapidly became the main contributor to the economy. This sudden change in the economic structure created waves of rapid migration from the rural areas to the urban centres, in the search for more lucrative non-farming jobs. The result of this change has the proportion of the rural population to the total population of the country to drop from 80% in 1958 to about 30% in 1968. Consequently, as farmers migrated, their lands were virtually abandoned, and erosion from the elements dispersed the fertile topsoils and trees were lost.

One of the immediate results of this change in the rural-urban structure was a sudden increase in demand for foodstuffs in the big cities. In 1968 the value of the imports of the food reached about LD16 million, which was only a little below the annual value of agricultural production ⁽¹⁸⁾

The above-mentioned circumstances led the Libyan government to execute the first five-year agricultural development plan for 1963-68, which was designed and prepared with the assistance of the World Bank for Reconstruction and Development at the invitation of the Libyan government in 1960⁽¹⁹⁾. The outline of the five-year plan was originally set intended to commence in April 1960, but due to the financial and political circumstances the plan was postponed until 1963.

The original allocations for this plan were LD 8.17 million (\$22.8 million) or about 32.7% of the total budget of the economic plan (See Table 2.2). In a supplementary report the Bank proposed an additional amount of LD 1.5 million (\$4.4). Thus, the total budget for the agricultural plan reached LD 9.7 million or 26.4% of the total sum allocated for the whole economic plan. The annual average expenditure was proposed to be LD 812,000 (\$2.7 million).

In August 1963, the Libyan Parliament approved the first five-year agricultural development plan for the years 1963-1968 and the allocation for this plan was estimated at LD 29.275,million (See Table 2.3). The allocations for 1963-1964 and 1964-1965 were LD 2.35 million and LD 4.85 million respectively. ⁽²⁰⁾

As a result of the implementation of the six-year plan (1963-1968) the contribution of agricultural production increased from LD 17.3 million in 1962 to LD 21.5 million in 1967, representing an annual increase of about 4.5%. In 1968, however, it dropped to LD 12.1 million (See Table 2.1).

2.2.4. The Fourth Agricultural Development Plan, 1969-1974

The fourth or effectively the second agricultural development plan was considered a follow-up to the first plan of 1963-69, with supplementary aims and objectives. The proposed draft of this plan was approved by the Libyan government on March 27, 1969 and it was designed to be implemented during the period between April 1969 and March 1974.⁽²¹⁾

The allocation for this plan was LD 49.9 million (\$140 million) or 13.6% of the budget for the whole economic plan. Allocations for the fourth agricultural development plan were nearly double those proposed for the first plan and about six times that proposed by the World Bank in 1960 (See Table 2.4). However, this budget was rejected by the First of September Revolution in 1969.

2.3. Agricultural Development Planning, 1969-1985.

2.3.1. Agricultural Development Programmes for 1969-1972.

After the September Revolution, agriculture and industry were given first priority in attention and expenditures. The revolution authority from the very beginning believed that oil revenue, should be invested mainly in the development of agriculture and industry, because both these sectors comprised the cornerstone of a secure and strong economic foundation which could, in the future, replace petroleum. It was believed that no country could safely rely on a single resource for economic strength

The Revolutionary Command Council approved a budget for agricultural development of LD 50 million (\$140 million) for the fiscal year commencing from

April 1970 to March 1971,⁽²³⁾ whereas the actual expenditure on agricultural development from September 1969 to February 1970 was only LD 16.920,000 (See Table 2.5).

In general, the allocations for the various projects in 1970-71 increased by more than 100% compared to the allocation for 1969-71. However, programmes in marketing, credit and government assistance to farmers decreased by 32.1%. Table 5 shows also that the budget for 1970-1971 increased to 195.5% of that for 1969-1970. The share of the land reclamation of the year, 1970-1971, gained the highest percentage (56.8%) of all programmes of the agricultural plan. The land reclamation allocation increased by 711.7% from the budget of the previous year.

Allocations for agricultural development for the periods 1971-1972 and 1972-1973 were LD 50.4 million, and LD 64 million respectively. The budgeted increase between 1971 and 1972 was very small (0.8%) while between 1972 and 1973 it was 21.3% greater than that of the previous year.⁽²³⁾

The revolutionary government was convinced that long-term planning for agricultural development was of vital importance to the economy of the agricultural development of the rural community, as well as in safeguarding food supplies for the urban population, which was so far mostly imported from abroad. In addition, it had learned from past experience that no plan could be expected to succeed unless it was well researched, designed in detail and carefully implemented. Consequently, four ministerial committees were established at the beginning of 1972. These committees were given responsibility for investigating existing agricultural conditions and exploring the most effective possibilities for agricultural development throughout the

country. Each committee consisted of several experts who specialized in various fields in the agriculture sector as well as in other sectors of the economy, and was headed by a Minister. Each committee was assigned to one of the four main regions selected for agricultural development. These regions were:

- 1. Sahil Jefara (Jefara Plain)** comprised of the Jefara plain, the highlands of Jabal Tripoli and the coastal area between Misrata and Khoms.
- 2. Jabal El Akhdar** consisted of Jabal El Akhdar Mountain, the Benghazi plain, and the coastal strip between Darna and Tubruk.
- 3. Fazzan** including the Sabha area, Wadi Ash-Shati, Wadi El Amal, Ubari-Ghat area, Murzuk basin and Ghatroon area.
- 4. Kufra-Es-Sarir** region comprised the agricultural project of El Kufra, the Sarir (which specialized in cereal production) El Haw-Wari, Tazirbu, and Jalo-Awjla agricultural settlements.

By November 1972 the four committees completed their task and subsequently submitted their final reports to the Ministry of Planning. These reports were considered the basic foundation for the three-year development plan, 1973-1975 and the subsequent five-year transformation plan, 1976-1980.

The construction of agriculture had to be vigorously pushed through with subsidies to farmers who were in real need. Vast injections of social overhead capital were required, as was of course land reclamation and agricultural settlement. In order to achieve these ambitious aims, a well designed, long-term plan for agricultural development was outlined for the period 1973-1980 which was divided into two major plans: the three-year development plan, 1973-1975, and the five-year transformation plan, 1976-1980.

2.3.2 The First Revolution's Agricultural Development Plan, 1973-1975.

The three-year comprehensive agricultural development plan was the first plan organised by the First of September Revolution and was considered as phase the first of a long-term plan which would be followed by subsequent five-year transformation plans. The capital investment allocated for the three-year agricultural development plan was LD 416 million or 25.3% of the whole economic plan with an average expenditure of LD 105.4 per annum. In this plan, the integrated agricultural development programme gained the highest percentage ratio of the agricultural sector. Its share was 66.8% of the total budget, followed by the marketing and storage programmes (4.9% each). credit and assistance programmes (4.7%), Wadi (dry valleys) reclamation (4.2%) and land reclamation and development (8.3%) (See Table 2.6).

For the implementation of the plan in the first year in 1973, certion new projects appeared to be necessary. Thus, new agricultural projects were introduced. As a consequence of the addition of these new projects, more financial support was needed for the execution of the plan in the following year. However, the amount of additional funds reached LD 150,930,000 or 26.6% more than the original allocation (See Table 2.4).

The sum allocated for the integrated agricultural development (LD 278,128,000) (See Table 2.6) was mainly spent on land reclamation, farmhouses, irrigation, and agricultural machinery for the newly established agricultural settlements. However, the integrated agricultural development and agriculture and agrarian reform will be given below within the discussson of the five-year transformation plan, 1976-1980.

The share of the agricultural output to GDP was 75.9 million (\$162 million) in 1972, while in the fiscal year 1962 it had only been LD 17.3 million. Hence, the nominal value of agricultural production increased by 235% within one decade.

The per capita net income in the agricultural sector increased by about 101.7% from LD 316.5 (\$886.20) in 1964 to LD 636.6 (\$1782.48) in 1972 whereas in other sectors it had increased by 210% during the same period. From this comparison it seems obvious that agricultural development was still lagging behind other areas of planning. However, more attention, care and capital investment were needed in order to increase the availability of agricultural land and to promote agricultural production and productivity to meet the demand for the domestic need for food, as well as to create more jobs for the available manpower in order to improve their standard of living and to achieve equality in the distribution of wealth between different sectors of society.

The most important and vital target of the three-year agricultural development plan 1973-1975, as well as of the subsequent five-year transformation plan, 1976 -1980, was to reach self-sufficiency in the production of basic foodstuffs within a period of 8 to 10 years. Specifically, the three-year plan set out the following eleven major objectives :⁽²⁴⁾

1. To reclaim 600,000 hectares of land or 43.8% of the area assigned for the long-term development programme.
2. To increase the local production of wheat from 80,000 tons in 1972 to 200,000 tons in 1975. This increase would raise the share of wheat production in terms of general domestic demand from 25% to about 50% (See Table 2.7).

3. To increase the local production of barley from 135,000 tons in 1972 to 200,000 tons in 1975. This increase of barley would raise local supply from 70% to 80% of domestic demand.
4. To increase the local production of vegetables from 230,000 tons in 1972 to 345,000 tons at the end of the plan.
5. Fruit production was also projected to increase from 120,000 tons to 150,000 tons during the plan period, 1973-75.
6. Meat production, mainly of lamb, goat and beef, had to increase from 29,000 tons in 1972 to 39,000 tons in 1975. This increase of meat production would attain 50% of the local demand.
7. Milk has nowadays become a very important and essential ingredient of the daily Libyan diet, while in the past it was considered a luxury drunk only by very few people. Therefore, the plan was designed to increase milk production from 56,900 tons in 1972 to 95,000 tons by the end of the plan. This increase would provide for 75% local demand.
8. Eggs also became important in the Libyan diet, particularly in the urban centres, and demand was increasing. Thus, the plan was designed to increase egg production from 4,900 tons in 1972 to 8,100 tons in 1975.
9. Honey was still produced in small quantities and its consumption was also limited to a very few people. The plan, however, was designed to increase its production from 29,000 tons in 1972 to 164,000 tons in 1975.
10. Olives were the only agricultural commodity the production of which the plan intended to decrease. It was proposed that olive production had to be reduced from 95,000 tons in 1972 to 70,000 tons in 1973, 80,000 tons in 1974 and 85,000 tons in 1975 respectively. ⁽²⁵⁾

11. Legumes and oil seed production were to increase during 1972-1975 from 15,000 to 98,000 tons and from 21,000 to 85,000 tons respectively

After three years of hard work, struggle and inspiration, the plan made a pronounced gain in agricultural production and animal products, as detailed in Table 2.8. In addition to agricultural production, the plan reclaimed about 329,457 hectares of land, or 75.5% of the planned target by the end of 1975 (See Table 2.9).

The building of 2661 farm units in agricultural settlements achieved 21.4% of the long-term target. 1100 km of paved roads were built, reaching 35.5% of the long-term target. Secondary paved and unpaved roads reached 2810 km. Finally, 3580 farmers were trained with agricultural machinery and modern agricultural techniques during the plan period, 1973-1975 (See Table 2.10).

All in all, agricultural development during the three-year development plan made slight but significant gains. Agricultural products accordingly increased considerably, except in meat, fruit and wheat production. Thus, the three-year development plan was followed by a subsequent five-year transformation plan, 1976-80, in order to achieve the further development of such commodities.

2.3.3. The First Agricultural Transformation Development Plan, 1976-1980

The implementation of the three-year plan in agriculture, as well as in other sectors of the economic and social development plan, faced various problems and impediments during the execution period between 1973 and 1975. Nonetheless, some positive achievements recorded in a relatively short period of time. The most

important factors preventing the complete success of the plan were a lack of experts and of detailed studies of the natural resources available as well as guidelines for their use. Agricultural technicians well-trained farm labour, and consulting and constructing companies were scarce, and there were few well trained personnel to supervise and coordinate the work in a healthy way. ⁽²⁶⁾

This situation led the government to undertake the design of more effective plans to promote and develop the agricultural sector in order to continue the drags of some projects in addition to implementing new projects. Thus, the five-year agricultural transformation plan, 1976-80, came into being with better planning and more efficient design.

The transformation plan was prepared and carried out in the spirit of socialism through the determination and participation of all the national capacities in the attainment of such ambitious objectives. It was so conceived as to depict the continuous resolution of the Libyan people to overcome their past backwardness and hunger by laying the sound foundation for self-sustaining spontaneous development plan which would help to strengthen the economy and raise the per capita income of farmers.

The five-year agricultural transformation plan, 1976-80, in its official aims and objectives, set out to pursue the agricultural lines of the three-year development plan, 1973-75. However, its mainstay was to build the economy and social life on firm foundations principally though coordinating various needs with the natural resources available for the improvement of the living conditions and the achievement of the

people's much desired aims of security from hunger, dignity, and prosperity, in order to help to create a strong country and a healthy community.

The plan itself took into account the freeing of the Libyan economy from reliance on a single product (petroleum) by broadening the base of agricultural production and ensuring the diversification of the national income. In general, the plan was designed around five major objectives: ⁽²⁷⁾

1. To increase the share of agricultural production in GDP.
2. To reclaim and develop an area of 100,493 hectares of irrigated arable land and 256,810 hectares of dry-farming land, in order to increase cultivated land from 143,286 hectares in 1975 to 357,303 ha by the end of the plan in 1980(See Tables 2.11, 2.12 and 2.13).
3. Grazing land was also designed to be expanded in order to increase its capacity to absorb more herds of sheep, increasing capacity from 4 months to six months per annum.
4. To increase land for irrigated fodder crops for animal feed from 40,000 ha in 1975 to 72,000 ha in 1980.
- 5 To increase agricultural production in order to attain self-sufficiency in basic foodstuffs, as well as to increase production in other economic commodities within the framework of the long-term agricultural development plan.

Since 1972, agricultural policy had been divided into two main areas the agricultural and agrarian reform, and integrated agricultural development. Each was run by a separate public organization.

Agricultural and agrarian reform was undertaken by the Secretariat of Agriculture and Agrarian Reform, and integrated agricultural development was under the Council for Agricultural Development. The main function of the Secretariat was to develop and promote agricultural production and productivity in the existing cultivated lands by means of vertical direction, whereas the Council was responsible for horizontal expansion in agricultural production through the reclamation and development of new arable lands. However, after lands were developed and settled, they were handed over to the Secretariat for supervision and further development, particularly in the vertical direction. (For a complete understanding of the program, its range of activities and achievements, see Appendix A.)

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2.3.3.1. The Integrated Agricultural Development Plan, 1976-80.

The main task of the Council for Agricultural Development was to reclaim and develop new arable lands for the implementation of the Integrated Agricultural Programmes. These programmes comprised the following objectives:

1. The creation of new agricultural settlements in various parts of the country.
2. The revival and development of abandoned and neglected former Italian demographic settlements.
3. The reclamation and development of new arable lands for the creation of public projects such as the cultivation of cereals (mainly wheat and barley), the cultivation of fodder crops for sheep and cattle raising, and the planting of tree crops for fruits production, and the afforestation of new lands.
4. The resettling of the nomads, semi-nomads and farmers from remote poor oases in new agricultural settlements established in various parts of the country.

The mainstay of Integrated Agricultural Development was the creation of agricultural settlement projects in the following areas: ⁽²⁸⁾

i. Jefara Plain Region. This project comprises the Jefara Plain, the highlands and terraces of Jebal Tarabulus, and the Khoms Misrata area.

ii. Jabal El Akhdar Region. This area comprises Jabal Al Akhdar (the Green Mountain itself) the Sahil Benghazi plain, the coastal strip of Marmarica (around Tubruk) and the Bulut area south of the foothills of Jabal Al Akhdar.

iii. Kufra and Es-Sarir Region. This area comprises the Kufra agricultural project area, 3 km south east of El Jowf, the central oasis, the Sarir agricultural project area, Jalo- Awjla and Marada Oasis.

iv. Fazzan Region. This area comprises Sabha, Wadi Ash-Shati, Wadi El Amal (formerly Wadi El Ajal), El Aweinat-Ghat, the Murzuk basin and the Wadi El Ghatroon area.

v. Es-Sulul El Khudur Region. This area comprises several Wadi beds in the southern slopes of Jabal Tarabulus and south of Sirt. This area was added to the previous four areas in 1975. ⁽²⁹⁾

The total area designated for the Integrated Agricultural Development programme in the aforementioned regions during the period 1976-80 was estimated at 1,003,359 hectares. (See Table 2.24)

The five-year agricultural transformation plan 1976-80 was designed after the implementation of the three-year agricultural development plan, 1973-75, as a partial fulfillment of the long-term plan started in 1973 and which was expected to extend beyond 1980.

2.3.3.2. The Long-Term Plan for Integrated Agricultural Development Programmes.

The Integrated Agricultural Development Programmes consisted of 56 projects designed and planned for implementation in the five aforementioned regions. However, most of these projects were initiated under the three-year plan, 1973-1975. One of the main objectives of the five-year Agricultural Transformation Plan (1976-1980) was to complete the planned projects by 1980 or at most during the subsequent plan, in 1981-1985.

The plan's target was to establish and develop the following projects: ⁽³⁰⁾

- .41 projects for agricultural settlements
- .6 projects for field crops production
- .5 projects for pastoral settlements
- .4 projects for forests and afforestation

The main goal of the long-term agricultural development plan was to reclaim and develop about 1,373,216 hectares according to the following arrangement: ⁽³¹⁾

1. 439,421 ha for the cultivation of cereals, vegetables and tree crops, of which 157,543 ha would be irrigated land and 281,878 ha dry farming land. This area was eventually divided into 12,619 farm units. Some areas, however, were retained under the responsibility of the Council for Agricultural Development for field crop and fodder crop production (See Table 2.25).
2. 833,800 ha for pasture and afforestation.
3. 100,000 ha for the growing of cereal crops in the Jefara plain.

4. In addition to the area assigned for cereal cultivation in the Jefara Plain, several areas were planned for long-term development for cereal cultivation.⁽³²⁾

The Council, in addition to the reclamation and development of the above mentioned areas for the creation of agricultural settlements, increasing production and productivity and improving livestock production, was also engaged in agricultural training via adult education, home economics for girls, and machinery and farming training for farmers and their families.

In order to achieve the aforementioned objectives for the long-term programme, several affiliated projects had to be executed alongside land reclamation and development. These were as follows:

- a. To drill 3485 productive wells to produce enough water for irrigation.
- b. To build 12,411 farmhouses in the agricultural settlements.
- c. To construct 3101 km of main asphalted roads and 8,386 km of secondary paved and unpaved (dirt) roads in the newly created agricultural lands.
- d. To train 19,316 new farmers and prepare them for resettlement in the new project areas. The plan also aimed to train the farmers in farming techniques and machinery as well as attending classes to overcome their illiteracy.
- e. To raise 260,778 head of sheep, 12,696 head of cattle, 995,500 poultry and 28,350 beehives (See Table 2.26).

These programmes were mostly to be achieved during the five-year transformation plan, 1976-80. The remainder was intended to be completed during the subsequent plan, in 1981-1985.

2.3.3.3. The Integrated Agricultural Development Programmes and Projects.

The Integrated Agricultural Development Transformation Programmes implemented for the plan period of 1976-80 were to reclaim and develop about 1,003,359 ha, or 73.2% of the long-term programme. This area was utilized for the following land use patterns (See Table 2.24).

- i. 303,709 ha or 30.3% of the total area was designated for the cultivation of cereals, tree crops, and vegetables.
- ii. 654,620 ha or 65.2% of the reclaimed area for the development of pasture and forestry.
- iii. 45,030 ha or 4.5% of the total area was designated for the cultivation of cereals, (mainly wheat and barley) in the Jefara plain (See Table 2.24). Jabal Al- Akhdar and the Jefara plain represented the highest percentage areas of the planned programme of land reclamation for field crops (grains, vegetables and fruits) at 38.1% and 33.9% respectively. Concerning the area designated for pasture and afforestation, the Jefara plain, Jabal El Akhdar and Es-Sulul El Khudur represented 35.1%, 34.1% and 30.8% respectively of the planned area.

2.3.3.4. Projects for Public Service Activities.

In addition to the main task of reclaiming and developing arable lands for agricultural production and settlements in the Integrated Agricultural Development Programmes, the plan was also designed to create the following public services for the development of agricultural production and welfare of the farmers, particularly in the newly established agricultural settlements. These were:

1. To drill 2,325 productive water wells for irrigation. These wells, in addition to the 1160 wells drilled during the implementation of the three-year development plan, 1973-75, would thus cover 100% of the long-term plan. This amount of wells would produce enough water to irrigate the proposed irrigated area of 157,543 ha (See Tables 2.25 and 2.27).
2. In order to furnish dwellings for the new selected settlers, the plan had to build 9,750 farmhouses, of which the Public Housing Organization constructed up to 3,000 houses. The rest, however, were built by the Council.
3. In the field of transportation, the target plan was to construct 2,000 km of main asphalted roads and 5,580 km of secondary and unpaved agricultural roads. Thus, by the end of the plan in 1980, the total length of roads achieved in both plans would reach the target of the long-term plan (See Table 2.27).
4. The training programmes for farmers were designed to train 15,740 workers in agricultural practices and equipment and machinery use. By the end of the plan in 1980, the number of trained workers in both plans would reach 19,316 as envisaged in the long-term plan.
5. Concerning animal husbandry, the plan was designed to maintain 158,300 head of sheep, 12,000 head of cows, 490,000 poultry, and 25,000 beehives. By the end of the plan in 1980, actual numbers reached 260,778 head of sheep, 12,696 head of cows, one million poultry and 28,350 beehives⁽³³⁾ (See Table 2.26).

2.3.3.5. Allocations for the Integrated Agricultural Development Programmes.

The original allocations for the Integrated Agricultural Development programmes were LD781,300,000 (\$2.1 billion) or 63.7% of the budget allocated for the agricultural sector (See Table 2.22). This sum was planned to be spent during the

plan period of 1976-1980. The average annual expenditure accounted for LD156 million (\$437 million) or 21.2% of the total budget. The allocations for 1978 reached LD336 million (\$942 million). However, the main purpose of these large allocations for the Integrated Agricultural Development programmes was to guarantee the continuation of the implementation of the agricultural settlements which were initiated in the previous plan 1973-1975 within the five selected regions.

Jefara plain and Jabal El Akhdar projects alone gained about 53.2% of the allocations designed for the whole programme (See Table 2.28). In addition to these five projects, the budget for Integrated Agricultural Development included also allocations for the Agricultural Company, with LD2.5 million (\$7 million) or 0.3% of the total budget.

At the end of the fiscal year 1976, the allocations for Integrated Agricultural Development were increased to LD 857,760,000 ⁽³⁴⁾ (\$2.4 billion) or 9.8% more than the first allocations (See Table 2.29). The allotted sums for the fiscal years 1977 and 1978 consequently reached LD 176,00,000 (\$492.8 million) and LD 227,600,000 (\$630 million) respectively. The percentage increase of the allocation for 1977 over 1976 was 16.8% for 1978 it was 37.2%. These increases were due mainly to the fact that prices of construction were steadily rising year after year, in addition to the expansion of some projects and the adding of new ones.

2.3.3.6. The Achievements of the Agricultural Sector.

Despite some problems and impediments which faced the implementation of the plan during its first two years in 1976-77, the results showed very encouraging progress.

However, data concerning the achievements in the Agriculture and Agrarian Reform Programmes is not available at present, whereas a comprehensive account of the achievements of the Integrated Agricultural Development programmes were published periodically in the official reports.

The statistics in the area of land reclamation showed that the Integrated Agricultural Development Programme achieved about 66.8% of the total planned (See Table 2.30). The area reclaimed and developed for the purpose of field crop cultivation in 1976 was 71,125 ha or 23.4% of the target and by 1977 it was about 186,432 ha or 61.4% of the targets plan. The area reclaimed and developed for pasture and forestry reached 385,212 ha with an increase of 226,032 ha or 124.0% over the area reclaimed for the cultivation of cereals in the Jefara plain, it is clear from (See Table 2.30) that the area reclaimed in 1977 for cereal production reached 43,944 ha or 97.6% of the target plan. By the end of the plan in 1980, the total area reclaimed reached the long-term plan's target of 100,000 ha.

Achievements in fruit trees plantations during 1976-77 reached 19,030,167 trees, of which about 58.9% were planted in Jefara plain and Jabal Al Akhdar alone (See Table 2.31). Forest trees, likewise, were planted very intensively, particularly as windbreaks and for sand dune stabilization. The number of trees planted during 1976-1977 reached 89,796,961 of which about 60.9% were planted in the Jefara plain alone.

The achievements of the agricultural production from the integrated Agricultural Development Programmes for the years 1976 and 1977 showed paradoxical results, where the production of some crops showed slight decreases from 1976 to 1977,

while other crops slightly increased. For example, wheat and barley production decreased by 5.8% and 3.6% respectively. Conversely vegetable and fruit production showed relatively high increases particularly for fruit. Overall vegetable and fruit production increased by 37.0% and 92.3% respectively (See Table 2.32).

Livestock breeding decreased markedly in all animals except for cattle which showed an increase of 8.3%. Animal products showed considerable increases, particularly in milk production which grew by 42.6%. Honey production also considerably increased by 24.0%.

Achievements in infrastructure showed considerable progress. Since the implementation of the three-year development plan up till the end of 1976 there were 1766 productive wells dug in various projects throughout the country. Then 606 wells were built during the first two years of the five-year plan. The total of productive wells achieved by 1977 represented 76% of the long-term target (See Table 2.27).

Asphalted main roads to facilitate transportation for farmers in the new agricultural settlements reached about 1692 km in 1977. Secondary paved and unpaved roads increased from 2810 km in 1975 to 7531 km in 1977, with an increase of 168.0%. Farmhouses built increased from 2661 in 1975 to 5898 in 1977, an increase of 121.7%. The total built by 1977 represented 54.9% of the long-term target.

One of the main objectives of the agricultural education programme was to prepare and train new farmers in modern farming practices methods and techniques as well as the usage of farm machinery and equipment. Thus, the new farmers had to be well

trained even before they were given their farms. Consequently, the plan paid close attention to and exerted great effort in training the new farmers, particularly the nomads and semi-nomads who had no previous experience in settled agriculture. As a result of this intensive training programme, the number of trained farmers increased from 3580 in 1975 to 7709 in 1977, an increase of 115.3% representing 53.7% of the long-term target (See Table 2.27).

All in all, it must be concluded that, according to the results obtained in the first two years of the plan, 1976-1977, except for wheat, barley and meat, the others achieved their targets by the end of the plan in 1980. Yet some projects, such as land reclamation, afforestation, fruit poultry and honey production, fell short of the target plan of 1976-80.

It seemed clear, however, that the capital surpluses from oil revenues, the massive construction of infrastructure and the discovery of huge underground water in the Kufra Sarir region, Bani Walid basin, Murzuk basin, and El Bulut area should in the following decade or so revitalize abundant agricultural lands and expand further land used for agriculture, which would consequently promote agricultural and animal production. Therefore, it seemed quite possible for sufficiency in principal foodstuffs to be achieved.

2.3.3.7. Problems and Impediments of Development Plans in Libya, 1973-1980.

The implementation of the agricultural transformation plan 1976-80 as well as any other sector of the whole economic plan in Libya, has encountered some serious

problems were lagging behind the target plan. This, however, was due to the following factors were important:

1. Water Shortage.

The most outstanding problem facing the execution of agricultural planning in Libya was and still is the shortage of water resources for irrigation. However, the unsatisfactory performance in agriculture at this time was not only due to shortages of water but also to the impact of traditional agricultural practices. Large areas of land were overexploited as a result of uncontrolled grazing, the use of fertile agricultural lands for the grazing of animals, the poor use of land cropping and the misuse of fertilizers and insecticides.

Underground water resources were rapidly depleting, particularly in the private sector areas (where water is improbably used for farming) at a rate ranging between 1-2m per year. In some areas such as Ez-Zahra, Gasr Ben Ghashir and Ain Zarah the water table was declining at a rate ranging between 2-4m per year. This situation forced the government to issue a rule in 1976 forbidding the growing of some agricultural crops, especially those requiring large quantities of good water such as tomatoes, watermelons, peanuts and citrus trees. In addition, the values of these crops in local market were comparatively lower than those of other crops which required less water. As a consequence, the Coastal Strip Project is undergoing presently, to eliminate the problem of water shortages in the Tripoli area.

2. Labour Shortage.

One of the main obstacles facing agricultural development plans in Libya has been the shortage of manpower, creating a wide gap between demand and supply. Before the discovery of oil, nearly 80% of the Libyan population lived in rural and desert areas. Thus, most of the labour force was engaged in agriculture and animal husbandry activities.⁽³⁵⁾ Therefore, the rural areas provided a labour force when agriculture was the only substantive natural source of national income. The rural population in 1980 was estimated at about 21% of the total.(Rawle Farley 1972) described this situation as follows: ⁽³⁶⁾"Even if Libya mobilized its contemporary educational resources and used all those available abroad, supply for the foreseeable decade still falls short of demand."

In 1960, two years before the export of crude oil began, 200,000 workers were engaged in the agriculture sector, while other sectors of economic activities absorbed only 15,000 to 20,000 workers.⁽³⁷⁾

Four years later, just two years after oil returns started pouring into the country, the labour force in the agriculture sector dropped to 144,853 workers or 35.7% of the total labour force in Libya.⁽³⁸⁾

Before the implementation of the three-year development plan, the number of workers engaged in the agricultural sector in 1973 was 163,500 or 29.3% of the total labour force. At the end of the plan in 1975, this number had decreased to 133,100 workers. Hence, the agricultural labour force declined between 1972 and 75 from 29.3% to 22.8% of the total labour force in Libya.⁽³⁹⁾

As a result of this unhappy situation with the agricultural labour force, the five-year Transformation Plan was designed to increase agricultural labour from 133,100 in 1975 to 157,800 workers in 1980. Thus the decline in the agricultural labour force meant a drop from 19.6% in 1975 to 17.0% at the end of the plan in 1980.

Therefore, the agricultural sector had to depend on foreign labour to undertake the implementation of most of its development plans for a considerable time, until the national labour force could meet demand. However, the chronic problems for contemporary agricultural development planning, as in other sectors led the government to issue a law in 1977 reallocating government workers such as drivers and genitors, who were under 40 years of age to productive sectors such as manufacturing and agriculture. In addition to this, the aforesaid law forbade the issuing of new licenses for any kind of activities to persons under 35 years of age.

All in all, thanks to the massive injection of financial support provided by oil revenues, and the large numbers of foreigners (441,000 experts, technicians and skilled and semi-skilled labourer in 1980) who were undertaking most if not all of the implementation of the agricultural projects, some positive growth was recorded during the first two years of the plan's execution in 1976-1977.

3. Marketing.

The agricultural sector of the Libyan economy suffered from instability in market prices and farm earnings. This was due to the low efficiency of many farm units, defects in transformation, educational backwardness among the rural population, and the greed of middlemen in marketing agricultural products.

4. Project Planning.

The lack of detailed prior studies in most of the agricultural projects caused many problems and obstacles during and after the implementation of various aspects of the projects, such studies would have thrown sufficient light on various aspects of the projects, and would therefore, have given signs of defects, that would have led to avoidance of mistakes and hence the saving of much effort, time and money.

5. Scarcity of Administrators.

Due to the magnitude of the agricultural projects and the relatively small number of well-trained Libyan administrators, the country had to depend, on foreign personnel to perform administrative jobs, not only in technical and professional areas, but also in simple administrative tasks. Most of the agricultural projects, particularly those situated in remote areas, were often implemented, administered and supervised by foreign staff and experts. However, the directorship of such projects was usually carried out by Libyans. These Libyan directors were in most cases appointed immediately after graduation from either the Faculty of Engineering or the Faculty of Agriculture, without having any previous experience. Thus, some of these new directors were faced with problems in both administration and professionally. This premature initiation, of course, often led to errors and probably the failure of projects.

6. Consulting Agencies.

One of the factors in defective planning in Libya was the absolute dependency on foreign consulting agencies in the design, supervision and execution of most of the agricultural projects. In most if not all projects the planners from foreign consulting

agencies never produced alternative strategies for the projects. Hence when problems arose, there was no way of changing course. Consequently, amendments had to be added to the original project or sometimes it had to be abandoned. This, of course, caused a considerable loss of effort, time and financial resources.

However, this defect can be overcome by advertising in international newspapers for international contests for planning design for any project of a big consideration. Consequently, the government will have the chance to choose the suitable plan from the presented contestant's design and naturally it will cost less than the previous procedures.

It is worth mentioning, however, that foreign consulting agencies have their own contacts with foreign contractors in most developing countries, where backwardness prevails among the majority of the people, a situation which was mostly aggravated by the lack of well trained personnel and experienced planners.

To sum up, it may be said that most, if not all, of the foreign consultants and contractors came to Libya to enjoy the petroleum bonanza in an easy way, rather than to help the country in its development for a better future.

7. Infrastructural Limitations.

Libya lacks natural seaports. This shortage caused port congestion in the existing small artificially constructed seaports, particularly after the beginning of the first development plan in 1973. The congestion of seaports caused many delays in the loading and unloading of the agricultural machinery and other commodities, and

particularly for materials for the previous and contemporary development plans. Thus, during peak periods for construction, the Libyan seaports were not capable of handling imported merchandise.

As a result of these deficiencies, most of the incoming ships were left floating on the high seas for a period extending from 20 to 60 days before they were allowed to sail into harbours. These delays increase of between 15 to 40% in the original costs, on the one hand, and the delay of projects which led to inflated prices and costs.

The cost of the projects was also affected directly or indirectly by the national and international political issues, because foreign contractors had to import all of the necessary machinery and materials for construction from abroad through sea transportation.

Transportation obstacles faced by the contractors were reflected in project implementation, and consequently caused delays or sometimes the failure of projects. Thus some of the agricultural projects which were initiated during the three-year development plan 1973-1975 were not completed as planned, but were instead integrated into the five-year transformation plan 1976-1980.

Therefore, foreign contractors, and particularly those with previous experience in contracts in Libya, always had to take into consideration the aforementioned circumstances whenever making bids for new tenders. As a consequence, the cost of projects increased indirectly year after year, costing the treasury considerably higher sums. Due to this experience with foreign contractors and consultants, in 1975 the government created state-owned and joint public and private contracting companies

for almost every sector of the economy and social transformation plan to resume responsibilities in executing public projects. However, due to the magnitude of the development programmes, these companies and organizations lacked the capability of executing such projects. Yet they still performed well and showed good results in implementing small-scale projects.

8. Projects Mislocation.

There were some inordinate delays in defining the locations for some projects, and difficulties were experienced in getting the authorities concerned to sanction the availability. Due to the lack of detailed geographical information, the locations of some projects had to be changed after the beginning of their implementation. This, of course, wasted time and effort and led to extra financial expenditure.

9. Lack of Coordination.

Coordination between different parties in the field of agricultural development planning, in other sectors, was weak and in many cases completely nonexistent. Coordination and sometimes even cooperation were also lacking between the Secretariat of Agriculture and Agrarian Reform and the Council for the agricultural

Development, on the one hand, exists between these two agencies and the agencies of electricity, public utilities and roads, on the other. This attitude between the different concerned agencies led to the delays in some projects and consequently raising costs and sometimes the failure of projects.

2.3.4. The Economic and social Transformation Plan, 1981-1985.

2.3.4.1 The Strategies of the Plan.

Because of the different economic and social changes faced in Libya, there was an obligation pressed on the plan toward the orientation of the Libyan people to various productive areas, where the agricultural activities given the priority in those areas. Therefore, it is possible to allocate the main tendencies of the Agricultural Transformation Plan according to the following strategies :⁽⁴⁰⁾

- 1- The realization of possible levels of agricultural production sufficient to reach self-sufficiency, particularly in grains, vegetables, fruits, meat and dairy production, with special care given to palm and olive trees.
- 2- The protection of Libyan natural resources, i.e. soils and underground water. At the same time these should be developed to realize optimal investment in their usage.
- 3- To raise the standard income levels of those who were engaged in agricultural reclamation and agrarian reform to give standards of living competent to the standard of those workers engaged in other productive sectors.
- 4- To promote and develop the utilization of agricultural land, and to stop the land fragmentation phenomenon, and collecting the agricultural production in economic units, that guarantee, the economic returns from the agricultural projects.
- 5- To realize local balance in the agricultural development areas by means of constructing settled residential centres for the new agricultural production.
- 6- To develop and promote natural pasture, and to divide it into fenced plots in order to prevent over-grazing, and also to plant the land with new varieties of grasses and pastoral shrubs so as to increase its share in agricultural and meat production.
- 7- To increase agricultural productivity by means of encouraging the farmers to utilize modern technical methods of farming applying the following means;

fertilizers, insecticides, good varieties of seeds and fodder, and agricultural tools and machinery.

8- Encouraging agricultural research which should be concentrated on the most important agricultural activities Conservation of soils, water, application of fertilizers, insecticides, and the study of pasture promotion, and the remedy of the desertification, and animal breeding, as well as, other subjects, those, affect the increment of agricultural production vertically and horizontally.

However, the probability of the increment of water resources, during the plan, was considered one of the most important elements on which the agricultural evolution and expansion can stand in the future. However, it was expected, that, the irrigated lands will increase to about 80% of the total increment of the agricultural production, between the years 1980-2000⁽⁴¹⁾. This came as a result of a study carried out by the Secretariat of Planning.

2.3.4.2. Aims of the Transformation Plan 1981-1985 in the Area of Integrated Agricultural Development.

The aims and objectives of this plan were to realize better economic returns from natural resources as well as producing large agricultural production, in order, to cover large proportion of self-sufficiency, during the plan period, with the increment of the actual investment in realizing the promotion of agricultural production during the plan's period, 1981-1985. The above-mentioned plan has eliminated its aims on the following: ⁽⁴²⁾

1.Reclamation and completion of the development of an area of about 69089 ha of irrigated land and another area of about 552579 ha of dry farming land to increase

the capacity of pasture. In addition, an area of about 1, 202, 27 ha of arable land would be reclaimed and developed to guarantee more good pasture, with grazing arranged for more animals in order to produce more meat.

2-Executing, developing and promoting the coastal strip (Ash-sharit As-Sahili) in order to realize the ideal investment of the agriculture land in the Jefara plan in such a way as to minimize the volume of water invested in agriculture. The irrigation water used in this area would decrease from about 636 million m³ in the year 1980 to about 198.8 million m³ yearly by 1985. Hence, this would about 437.2 million m³ yearly.

3-Increasing agricultural production from goods and alimentary crops to realize the highest possible level of self-sufficiency in wheat, barley and meat.

Table 2.33 shows the development of agricultural production during Transformation Plan 1981-1985 and its potential contribution to the realization of self-sufficiency in agricultural goods if the target was realized.

2.3.4.3. Agricultural Project Programmes of Transformation Plan 1981- 1985:

The agricultural programmes objects were the execution or accomplishment of agricultural projects previously studied in all fields, with explanation of methods and means that could assure the realization of these objectives. Also, endeavour would be made to surmount any obstacles hindering the execution of these projects by exploiting the previous experiences in the execution of the Transformation Plan 1976-1980. The following is a brief exposition of these programmes⁽⁴³⁾:

2.3.4.3.1. Programme of Agricultural Reclamation and Land Reform:

This programme undertook the task of realizing the accomplishment of projects for land reclamation and reform. The area of irrigated lands is 69,089 hectares and the unirrigated lands are 552,579 hectares. Also, this programme included the land reclamation and reform programmes in the regions of the Jefara plain, Jabal Al-Akhdar, As-Sulul Al-Khudur, Fazzan, Al-Kufra and Es-Sarir covering an area about 121,380 hectares of irrigated lands 1,083,097 hectares of unirrigated lands (See Table 2.34) Besides, the accomplishment of Al-Gawarsha projects of an area of about 958 hectares, the agricultural development area in Misrata of area 22,225 hectares and Shatt El-Badin project of area 6500 hectares. In addition to these existing projects, new projects were implemented including the reclamation and development of an area of 50,000 hectares in the central zone (Sirt Gulf), which has been developed through the Man Made River, by transportation of water from As-Sarir and Tazirbu to Ejdabya reservoir; and from there to Sirt region at Al-Gardhabiyah reservoir.

The programme planned to implement an area of 10,000 hectares or about 20% of the total programme of the projects and to bring it to production phase by the year 1985. Table 2.34 shows the objectives for the reclamation and development of land in the Transformation Plan 1981-1985.

2.3.4.3.2. Programme of Redevelopment and Promotion of the Coastal Strip:

The project of the coastal strip includes the region of Jefara plain in Tripoli region of 194,200 hectares. This plain is the biggest and the most fertile in Libya, containing the majority of agricultural and industrial production of the country.

The exploited water quantity in this plain is about 636 million m³ / year from the five underground layers reservoirs; the annual feeding does not exceed the quarter of the consumption. For this reason, annual drainage should not exceed 198.8 million m³, and if drainage continues in such quantities, the reservoirs of this plain will be exhausted sooner or later.

To reduce the risk of such a situation occurring, the Transformation Plan devoted considerable attention the redevelopment and promotion of the coastal strip in order to preserve underground water. Thereupon, the necessary studies were performed for the execution of the project, by examining water quality and quantity, soil quality, costing and economic return per hectare.

On the basis of the above-mentioned studies, the plan policy for the execution of this programme was dependent on the following points⁽⁴⁴⁾:

I. Grain sowing in the coastal strip should be limited to the unirrigated lands only, in order to save 65.4 million m³ of underground water per year. This required the transformation of an area of 34,700 hectares of irrigated land in 1980 into unirrigated land.

ii. Decline in the lands planted with vegetable and potato crops especially in this coastal strip to reach 9,650 hectares, and that, is in the first phase of the project aimed at the execution of about 31 million m³ of underground water. Moreover, vegetable farms annexed to other agricultural crops would be removed to save water. Due to the increased need for water for vegetables, the areas irrigated for vegetables could be increased, if the necessary quantities of water were available. This step would be applied during the second and third phases of the plan.

iii- Irrigated plantations for fruit would be reduced from an area of 43,120 hectares to 21,630 hectares at the end of the first phase of the project. This would save 152 million m^3 of underground water per year. The removal of all old and sick trees and especially citrus trees would also be performed. In addition the irrigated areas planted with watermelon and melon was to be decreased. Their farming would be encouraged on unirrigated lands at wadi shores and beds.

iv- The usage of sanitary drainage water in the farming of fodder in the coastal strip in an area of about 27,280 hectares would save a quantity of underground water that could reach 176 million m^3 .

As a consequence of appliance of the coastal strip project, the quantity of drawn water was to be decreased from 363 m^3 per year to about 198.8 m^3 per year, and the lifetime of underground reservoirs would thus be extended from 25 years to 125 years. This procedure followed by decrease of irrigated lands in the coastal strip from 124,300 hectares to about 31,300 hectares, with an additional 23,000 hectares that would be irrigated by about 150 million m^3 /year of sanitary drainage water.

2.3.4.3.3. Grain Sowing Programme:

Grain farming in Libya was considered very important and its development, promotion and increasing production rates were thought likely to lead to self-sufficiency in the shortest possible time. For this reason a decision of the General People's Committee was issued in April 1980 stating the foundation of the General Board for Grain Production. This board aimed to develop the national economy through increasing grains production in such a way as to realize self-sufficiency. This board was charged with the execution and supervision of all grain cultivation

projects in the country and the origination of new areas to be exploited for grain farming. Beside, this it would take care of the arrangements for all production requirements, such as agricultural equipment and machinery, pesticides and means of transport.

The grain planting programme was intended to fulfil the following main purposes during the Transformation Plan:

- i- Increasing the local production of wheat from about 140,5 tons in 1980 to about 428,8 tons to satisfy 75.3% of local demand.
- ii- Increasing the local production of barley from about 71,5 tons in 1980 to about 105,6 tons in 1985 to fully meet of local demand(See Table 2.33).

The farming of grain in irrigated and unirrigated land was planned to realize the following aims:

A. Grain Production in Irrigated Lands:

This programme was performed by increment of grain farmed in irrigated lands from 24,010 hectares on 1980 to 61,883 hectares in 1985. Increment of production in wheat rose from about 66,500 tons on 1980 to about 346,800 tons in 1985. This was performed using the following steps:

- i. Accomplishment of current programme of irrigated lands, in addition to implementation of some new projects of about 37,873 hectares, of which 12,500 hectares in Fazzan region, 9,133 hectares in Kufra region, 6,240 hectares in Es-Sarir region, and 10,000 hectares in the central region. As a consequence to this increment, the new areas of production were expected to enter within the production area 1983-

1984 in Fazzan, Kufra and Es-Sarir, while Central Region area enters within the production of the season 1984-1985 at the end of the year of the plan.

ii. Private sector farms contribution in grains farming programme in irrigated lands is of 9964 hectares, i.e. about 16% of the total irrigated lands cultivated with grains. However, public productive projects contribution in the Jefara plain, Fazzan, Kufra, Es-Sarir and Central Region is of about 84% i.e. about 51,919 hectares of irrigated lands farmed with grains in the season 1984-1985.

As a consequence of these addition of irrigated lands, the grains production aimed to be realized in public productive projects is about 212,000 tons/year, i.e. about 86% of total production subject to realization of irrigated areas planted with wheat, while private farms production is estimated of about 34,800 tons/year, i.e. 14% of total production subject to realization in irrigated planted areas in the season 1984-1985.

iii. Increment of wheat production rates in irrigated lands to reach about 4 tons per hectare in public productive projects consecrated for grains production within the plan; while private sector irrigated farms is of about 3-3.2 tons/ hectare

B. Grain Production in Unirrigated Lands:

The plan in unirrigated grain programme aimed at the vertical development of lands devoted to grain production of an area of about 480,000 hectares, and that through increment of grain production rates per hectare from about 0.2 ton per hectare in 1980 to about 0.6 ton per hectare in 1985. In addition to wheat and barley production, the programme aimed at the farming of 120,000 hectare per year to be exploited in feeding 24,000 head of sheep in order to increase the local production of meat.

i. Wheat:

The plan aimed to achieve an annual production of wheat through unirrigated farming of 182,000 tons in the season 1984-1985. This could be realized by farming an area estimated at 288,000 hectares of unirrigated lands. Production rates per hectare would be between 0.5 and 0.8 tons depending on region and rainfall.

ii. Barley:

The programme of barley farming aimed at the realization of an annual production of barley through unirrigated farming of 105,600 tons in 1985. This would require the planting of an area estimated at 192,000 hectares of unirrigated land. Production rates per hectare were expected 0.5 to 0.8 tons.

iii. Vegetables:

The programme for vegetable production aimed to achieve an annual production of vegetables reaching about 779,000 tons in 1985 so as to satisfy about 95.6% of local demand (See Table 2.35) by farming an area of 31,000 hectares for vegetables in greenhouses. This would lead to a production of about 190 kg of vegetables per year per individual. The vegetable farming programme was distinguished within the Transformational Plan 1981-1985 with the following aims:

a. More concentrated vegetable-growing would take place in greenhouses owned by the public sector, so that the programme aimed to increase the area used for producing vegetables from 54 hectares with annual production of 6,000 tons of vegetables to 649 hectares with annual a production of 83,000 tons of vegetables in 1985. This programme is trying to encourage the private sector to under take this type of farming, as to guarantee a production that covers all the country in reasonable

prices. Farming in green houses is distinguished with producing a quantity of vegetables of about 135 tons per hectare, saving a large amount of water.

b. Declining the irrigated land, prepared for growing vegetables in the Coastal Strip areas, and increasing these areas in the south, oasis areas and the Central area.

c. The area of public land producing vegetables is nearly 3,720 hectares which is 12% of the total area for producing vegetables, most being located in the Es-Sarir project, whereas the area of lands intended for producing vegetables owned by the private sector is about 27,793 hectares which is 88% of total area intended for producing vegetables in the year of 1985 (See Table 2.35).

C. Olives and Fruit Production Programme:

The Transformational Programme expected to increase the number of fruitful trees from 2.7 million 1980 to about 13.7 million in 1985, with the targeted increase in fruit production from 312,000 tons in 1980 to about 344,000 tons in 1985 (See Table 2.33)

This programme aimed to decrease the quantities of irrigation water used by changing the method of irrigation from docks and sprinkler irrigated rain to special hydroponic systems, and by trying to improve the arboretums to produce modified trees in the required numbers. The number of arboretums approaches 13 specialized in fruit trees, estimation of production is about 9 million trees annually. The programme also depended on improving fruit trees already existing and improving quality.

For the cultivation of olive trees, the programme was working to limit its growing in the fallow lands in an area of 182,000 hectares to achieve the production of about 160,000 tons of olives in 1985. Concerning the improvement of palm trees, the programme was working to improve and develop planting palm trees in old farms, by choosing the most areas damaged by dryness in areas highly planted by palm trees estimated in numbers about 2.4 million trees, (52% of total trees in Libya).

D. Pasture Development Programme:

This programme aimed to maintain existing pastures and to develop them. This entailed the two following objectives:

- 1- Increasing the productive performance of pastures and animals in order to achieve self-sufficiency in meat, by developing fodder sources, organizing watering operations and improving the administration of flocks.
- 2- Protecting land from desertification by avoiding open pasturing and increasing green cover ⁽⁴⁵⁾

E. Forestry Development and Improvement Programme:

This programme aimed to both develop and improve the forests and to increase the number of trees in areas that received sufficient amounts of rain. This would allow the growth of wooded areas to strike an environmental balance, and redeveloping the natural forests which have been exposed to drifts due to the bad usage. Moreover, the programme aims to stop the desert advance and establishing industries based on woods. The plan aimed to achieve objectives through the following projects:

1. Sets Production Project:

This programme aimed to provide the needs of projects, municipalities, and private farmers, of forests sets by establishing arboretum for every municipality to fulfill all needs of different kinds of sets. Consequently, the plan aimed to increase the number of sets from 322 million to 500 million within 100 million trees per annum (See Table 2.36)

2. Afforestation Project:

This programme aimed to protect the trees, increase the woods production and strike an environmental balance in areas covered by the plan, combating desertification, to achieve this an afforestation to achieve an area of 165,405 hectare as forests and 63,443 hectare as wind breaks, with this the total area, by the end of the plan, would be at 228,848 hectares. (See Table 2.36)

3. National Parks:

The project aimed to maintain the natural resources in areas of the country, and saving the wild life, and protecting good rare species. The programme includes constructing wadi-Al Kuf, and Bier- Al Ghanam, Bier Ay'yad .

2.4. Achievements of the Agricultural Development Plan, 1970-1985.

It is worth mentioning that no assessment of the transformation plan of 1981-1985 has been published or publicized. However, it appeared with the overall development plan since the rise of the First of September Revolution (1969) up-till

the stoppage of the development planning programmes, that the following achievements have been realized during that period⁽⁴⁶⁾.

1. Land Reclamation and Development

During the plan's period of 1970-1985 it was estimated that 1.3 million hectares of land were reclaimed, compared to the plan's target of 3.0 million – a shortfall of about 60%.

2. Agricultural and Animal Production

1- Increment of wheat production from 27,2 tons in 1970 to about 210 tons in 1985 with an increase of annual compound rate of about 14.6%.

2-Increment of barley production from 52,8 tons in 1970 to about 105.0 tons in 1985 with an annual increase of compound rate of 4.7%.

3- Increment of vegetables production from 205,200 in 1970 to about 827,500 tons in, 1985 with an annual increase of compound rate of 9.7%.

4- According to 1984 results published General Agricultural Statistics⁽⁴⁷⁾, the number of trees increased to 39.5 million of which 8.4 million were olive trees, 4.2 million palm trees, and 3.8 million almond trees.

5- Increment of olive production from about 69.2 thousand tons to about 145 thousand tons with annual compound rate of about 5.1% (see Table 2.37).

In addition to crop and animal production, the transformation plan was accompanied by the necessary complementary development of agricultural roads of about 2,721 kms, and of 30, 31 wells drilled at an average rate of 198.5 wells per year. To this one must add the construction of 360 water reservoirs and the planting of about 27,271,043 fruit trees at an annual rate of 1.7 million (See Table 2.38).

6- In the area of forestry and pasture development and desertification remedy, it has been realized that the plan had led to planting of more than 207 million trees for forest, pasture and wind-breaks, besides the establishment of more than 32 grain silos, 80 grain storage, 350 agricultural co-operatives and 197 green-houses.

The number of farms distributed to farmers reached 11,314, at an average of 707 farms per year. During the 16-year plan, over 11,804 farm-houses were built, with an annual average at 737 houses, and these were distributed to settling farmers. In sum 2,661 beehives, 7,422 tractors, 11,260 ploughs, 1847 sower-tractor, 6149 draggers and 115 sowing tractors were also distributed to these farmers. In all agricultural training activities during the period. 1970-1985, there were about 10,842 trainees, giving an annual average of 678 trainees (See Table 2.38).

2.5. Investment in Agriculture

The huge investment in the agricultural sector expanded the agriculture in all parts of the country, with special tendency towards the integrated agriculture. For instance, the allocations for agriculture and agricultural development increased in real terms from about LD416 million in the Ternary Development Plan 1973-75, to about LD1227 million. Of this amount, about LD455 million was allocated to agriculture and improvements to the existing agricultural areas, and about LD782 million was allocated to the Integrated Agricultural Development Programme.

The total allocation over the period 1970-1990 reached about LD31 billion, of which LD5.2 billion (17%) was allocated to the agricultural development plans. This allocation were distributed to 14 sectors and the effective investment value in this

sector within the same period reached LD4.5 billion, with an execution rate of 86.5% from the total allocations for this sector.⁽⁴⁸⁾

These sums were spent on various programmes and agricultural developmental projects such as land reform and reclamation, the re-development of the coastal strip, the development and production of seeds, vegetables and fruits, development of pastoral areas and forests, animal resources, the construction of dams, water resources, the Man Made River water transportation programme, loans and agricultural assistance, education and agricultural training, agricultural guidance, and agricultural researches.

2.6. Agricultural Manpower:

Manpower is considered the main factor in agricultural development activities to improve the living standard for farmers and to develop their agricultural experience. Despite the development of the agricultural sector and improvements in conditions for farmers through the assistance presented to them by the government, there has been a clear decline in the numbers of working farmers. This is primarily due to the fact that Libyans have moved to work in other sectors of the economy, whilst expatriate workers have now moved to work in agriculture. Moreover, a large number of settling farmers who once depended on animal breeding through nomadism, have also left. Most people lived in the steppes and countryside, performing traditional and unirrigated pasturing for their adaptability with the dry conditions characterized in the country and in the areas where the rain is not enough for agriculture, they depended on wells and springs to perform their agricultural activities.

By the beginning of the second half of the twentieth century, the nomadic system started to disappear, and the nomads started to settle. For instance, the ratio of nomads and semi-nomads to the total population of Libya in 1954 was about 26% while to 1984 this had dropped to about 0.15%. This was the result of the settlement of the nomads in the government agricultural projects and the migration of so many farmers to urban areas once economic growth occurred in Libyan cities after the discovery of oil in the 1960s. The nomadic society was no longer isolated independent society anymore, instead they became bonded and dependent to the city in almost every way. The settlement of nomads in the city resulted in the disappearance of the old nomadic system in Libya, which depended on traditional pasteurizing and continual movement.⁽⁴⁹⁾

In general there is a clear tendency for rural inhabitants to migrate urban areas, to settle there and to work in commercial, industrial and service sectors. The statistics suggest that over the entire period of the study, rural-urban migration stood at 80%. The distribution of effective manpower in different economic sectors shows a clear decrease in percentage of workers in the agriculture in comparison with industrial and service sectors. In fact workers in agriculture in 1954 represented 59.5% of the total workforce, and this had declined to 21.9% by 1984, and further fell to 18.5% by 1990.⁽⁵⁰⁾ The underlying reason for this decrease in the farming workforce is the movement of young members of farming households to other economic sectors such as industry and services, primarily due to the significantly higher incomes in these sectors.

In addition, a survey in 2002 showed that a significant percentage of farm owners appear not to be wholly dedicated to agricultural work, and hence agriculture represents only part of their economic activity. According to this survey, agriculture as the main profession declined from 54.5% of farmers in 1974 to 36.3% in 2003.⁽⁵¹⁾

Foreign agricultural workers engaged in farming in Libya are predominantly wage earners, with a small proportion enjoying shares of agriculture yields. The use of mechanical machinery and the modern systems such as chemical fertilizers and insecticides have resulted in compensating for the shortage in the availability of workers and have enhanced agricultural production.

The integrated agricultural development plan seemed strong at the beginning of the 1970s and continued despite the rising of some agricultural obstacles, until mid-1980s. After the early 1990s, when UN and US sanctions were applied to Libya, agriculture suffered significantly as the importation of equipment, water pumps and agricultural material was halted. Moreover, the declining oil prices led to major problems overshadowing the success of development projects and resulting in the serious decline of agricultural output and farming incomes.

The integrated agricultural projects continued after 1985 only on a year by year basis, until present time through programmes for specified agricultural sector. Thus, research in agricultural development and the evaluation of settlement projects had ceased entirely by 1985.

Notwithstanding the halting off the economic and social development plans since 1986, Libya has recently prepared a quintet plan for development for the period

2001-2005 worth \$35 billion, complying with the requests to correct the economic balance according to the local, regional and international developments. This development policy aims to draw the attention of foreigners to participate in the execution of the programmes of such plan, aiming to improve the national income by not less than 5% per annum.⁽⁵²⁾ This plan will direct its projects towards the infrastructure such as water, roads, ports and airports, in addition to education and health, while the development of the rest of sectors will be left to the private sector investment.

2.7. Conclusions

This chapter has examined the agricultural plans since drawn up the Al-Fatah Revolution in September 1969. The First of September Revolution exerted considerable effort in developing the country, and gave high priority to agricultural development as a basis for self-sufficiency. Land settlement was one of the integral policies built around these agricultural development plans, aiming to provide free land and means of production for thousands of nomads and herdsmen. The plan aimed to offer salaries to working/settling farmers for a certain number of years, until such a time that they could market their products with or without the help of cooperatives to end users. The main source of financing was oil revenues.

Although land settlement as a social project appeared to make economic sense, other aspects of the agricultural plan based on self-sufficiency did not. Self-sufficiency in food may have been relatively important for a closed economy based on a socialist mode of production as in Libya between 1969-1990, provided that the country was naturally endowed with the main resources for agricultural development; namely soil

and water. As the Heckscher-Ohlin model of international trade suggests, a country with scarce factors will be expected to import products for which scarce factors are used intensively.⁽⁵³⁾ In this case, given that water is the most scarce resource in Libya, one would then expect the Libyan strategy to be one of the importation of agricultural products from the rest of the world, whilst becoming engaged in the exportation of abundant-factor intensive products.

In short, the land settlement project should be regarded as a social project aiming to improve the welfare of a large section of the population. However, using land settlement as a platform for economic efficiency or income generation has proven to be ineffective in the case of Libya.

ENDNOTES

- (1) Abdullatif, Al Barghuti, (1974). p. 257.
- (2) Ibid,p. 579.
- (3) Ibid,p. 310
- (4) Ibid.p.311.
- (5) Ibid.p.438.
- (6) Loc/cit.
- (7) Durant, W. (1959) p. 31.
- (8) Abdullatif Al Barghuti, op. Cit, p. 464.
- (9) Ibid,p.473.
- (10) Hajjaji Salem, A.(1970), p. 88.
- (11) Abdullatif Al Barghuti, op. Cit, p. 282.
- (12) Ibid, p. 285.
- (13) International Bank for Reconstruction and Development: 1966, p. 27.
- (14) Farley, Rawle (1972), p. 162.
- (15) Peter Beaumont et al. (1977), p. 490
- (16) Benerose, E (1970), p. 52.
- (17) Loc/cit
- (18) Farley, Rawle, op. cit, p.163.
- (19) Ibid, p.164
- (20) Ibid, p. 166.
- (21) International Bank for Reconstruction and Development, op. cit. p. 49.
- (22) Ibid, p.52.
- (23) Farley, Rawle, op. cit. pp. 198-200; and Benerose, op. cit, p.14.
- (24) Ibid, p. 199.
- (25) Benrose, loc. Cit, p. 11.
- (26) Ibid, p. 14.
- (27) Farley.loc. cit, p. 195.
- (28) Benrose, loc.cit, p.114.
- (29) Farley, loc. cit, p. 211.
- (30) Hujair, loc.cit,p.114.

- (31) Farley, loc. cit, p. 311.
- (32) Amer, Abdulgader Ay'yad (1970), p. 99.
- (33) Farley, loc. cit. p. 312.
- (34) Ministry of Information and Culture, Libyan Arabic Republic,(1975) General Administration for The First of September Revolution Achievements, 1969-1974, p. 37 (no details of programmes or projects are available).
- (35) Romberg, A. (1978), p. 3.
- (36) Ministry of Planning, Libyan Arabic Republic,(1972) The 3-Year Development Plan, 1973-1975, Tripoli, Libya, p. 11.
- (37) Ibid, pp. 40 and 176.
- (38) Ibid, pp. 178-88.
- (39) Ibid, p. 179.
- (40) Ministry of Planning, Libyan Arabic Republic, (1980) The 5-Year Transformation Plan, pp. 220-221.
- (41) Ibid, p. 221.
- (42) Ibid, p.176.
- (43) Ibid, pp. 179-85.
- (44) Ibid, p.p. 201-215.
- (45) Council for Agricultural Development, Libyan Arabic Republic, (1976) the Executive Committee of Sahil Jefara: With the March of Integrated Agricultural Development, (in Arabic), Tripoli, Libya, p. 7.
- (46) Council for Agricultural Development, Libyan Arabic Republic,(1974) The Garabulli Project, the Preliminary Report, Tripoli, Libya, p. 23.
- (47) Ibid, p. 23.
- (48) Beaumont et al:, loc. cit, p. 206.
- (49) Libyan Arab Republic, Ministry of Planning: The Five-Year Transformation, Plan, 1976-1980, p. 206.
- (50) From personal experience.
- (51) field work investigation, 2002.
- (52) The Economic and Social Transformation Plan 1981 – 1985, p.217.
- (53) For a recent review of this model and its extensions, see Robert Dunn, R. (2000), pp. 55-120.

TABLE 2.1
CONTRIBUTION OF AGRICULTURE AND PETROLEUM SECTORS TO
G.D.P: 1958-1968 * (LD million)

Year	Agricultural Sector	%	Petroleum Sector	%
1958	13.6	26.1	3.6	6.9
1962	17.3	9.4	51.5	28.1
1963	17.2	6.5	115.9	44.0
1964	16.3	4.8	197.5	52.3
1965	22.8	3.9	256.3	53.7
1966	21.7	3.9	309.1	55.0
1967	21.5	3.4	340.4	64.5
1968	12.1	2.0	950	92.0

Source: Amer., A. A. Economic Development Strategies For Libya. Unpublished MSc. Thesis) los angeles, 1970, p. 51.

* Figures for 1968 from: Hujair, M. The Libyan Economy. A Comparative Arabic Study (In Arabic), Maktabat Al Andulus. Benghazi – Libya. 1973, p. 35.

TABLE 2.2

**ALLOCATIONS FOR THE FIRST 6-YEAR AGRICULTURAL
DEVELOPMENT PLAN: 1960 - 1965 (LD MILLION)**

Development	Allocations	% of Agriculture	% of Economics
Water Resources	3.05	37.3	12.2
Forestry & Dune Fixation	1.52	18.6	6.1
Agricultural Crops	3.6	44.1	14.4
Total Allocations	8.17	100.0	32.7
Amended Total Allocations	9.7	—	26.4
All Economic Programmes	25	—	100.0
All Amended Economic Programmes	36.8	—	100.0

Source: International Bank for Reconstruction and Development, The Economic Development of Libya. Baltimore: John Hopkins Press, 1969.p.p 70-71

TABLE 2.3
ALLOCATIONS FOR THE FIRST 6-YEAR AGRICULTURAL
DEVELOPMENT PLAN, 1963 – 1968 (IN LD)

Programme	Total Allocations	% of Total	1963 – 1964 Allocations
Agricultural Settlements	10,000,000	34.2	500,000
Marketing	3,500,000	12.0	200,000
Water Development & Soil Conservation	3,500,000	12.0	200,000
Machinery	2,500,000	8.5	350,000
Pasture & Forestry	2,000,000	6.8	250,000
Animal Heath & Development	1,500,000	5.1	25,000
Extension	800,000	2.7	80,000
Horticulture	500,000	1.7	15,000
Plant Disease & Pest Control	400,000	1.4	50,000
Research & Experiments	700,000	2.4	15,000
Statistics	75,000	0.3	15,000
Credit	3,800,000	12.9	800,000
TOTAL...	29,275,000	100.0	2,350,000
All Economic Programmes	169,097,000	—	—

Source: Hujair, M. – The Libyan Economy op. cit. p. 112.

TABLE 2. 4

ALLOCATIONS FOR THE AGRICULTURAL DEVELOPMENT PLANS
1960 – 1980 (IN LD)

Plan Allocations	Amount	Increase	% Increase
Allocations proposed by I.B.R.D., 1960-1965	8,170,000	—	—
Amended Allocation for 1960	9,745,000	1,575,000	19.3
Allocations Amended by the Government (1960), for 1963-68	29,275,000	19,530,000	66.7
Amended Allocations for 1963-1968	49,900,000	20,625,000	41.3
Added Allocation for 1968-1969	61,000,000	11,100,000	18.2
Allocations for 1973-1975	416,134,000	—	—
Amended Allocation for 1973-1975	566,971,000	150,930,000	26.6
Allocations for 1976-1980	781,300,000	—	—
Amended Allocation for 1976-1980	857,760,000	76,460,000	8.9
Allocations for the Agriculture & Agrarian Reform, 1976-1980	445,296,000	—	—
Amended Allocations for 1976-1980	412,269,000	—	—
Allocations for Integrated Agriculture and Land Reform, 1976-1980	781,300,000	—	—
Amended Allocations for 1976-1980	857,760,000	—	—

Source: 1- International Bank of Reconstruction & Development (IBRD) The Economic Development of Libya, Baltimore: John Hopkins Press, 1960.pp.70-71
2- El-Jihad Newspaper Par.1427...30, 1977, p.11 (in Arabic).

TABLE 2. 5**ALLOCATIONS FOR THE AGRICULTURAL DEVELOPMENT
PROGRAMMES, 1969-1971 (IN LD)**

Programme	1969-70	1970-71	% Increase or Decrease
Research & Extension	135,000	325,000	140.7
Marketing, Credit, Assistance	8,585,000	6,500,000	-32.1
Water & Soil Conservation	3,100,000	8,140,000	162.6
Plant Production	350,000	1,331,000	280.3
Animal Production	150,000	2,710,000	1706.7
Pasture & Forestry	300,000	854,000	184.7
Land Reclamation	350,000	28,410,000	711.7
Agricultural Roads	800,000	1,730,000	116.3
TOTAL	16,920,000	50,000,000	195.5

Source: Hujair, M... The Libyan Economy; op. cit., p. 78.

TABLE 2. 6
ALLOCATIONS FOR THE 3-YEAR AGRICULTURAL DEVELOPMENT
PLAN, 1973 – 1975 (IN LD)

Programme	Allocations	% of Total
Land Reclamation	16,096,000	8.3
Wadis Reclamation	17,601,000	4.2
Underground Water	796,000	0.2
Pasture Land	2,000,000	0.5
Animal Production	15,541,000	3.7
Plant Production	9,050,000	2.1
Date Production	300,000	0.7
Forestry	6,200,000	1.4
Machinery	2,000,000	0.5
Extension	1,800,000	0.4
Marketing & Storing	20,400,000	4.9
Agricultural Roads	8,000,000	1.9
Credit & Assistance	19,900,000	4.7
Research, Statistics, Training	4,870,000	1.1
Share for Public Agricultural Co.	2,666,000	0.6
Hydrology Studies & Research	10,666,000	2.5
Integrated Agricultural Development	278,128,000	66.8
TOTAL	416,034,000	100.0

Source: Libyan Arabic Republic, Ministry of Planning. The Three-Year Economic & Social Development Plan, 1973-1975(in Arabic). op. cit., p.203.

TABLE 2. 7

**PROJECTED AGRICULTURAL PRODUCTION FOR THE 3-YEAR
DEVELOPMENT PLAN, 1973-1975 (IN TONS)**

Commodity	Estimated Production for 1972	Projected Production for 1975	% Increase or Decrease
Wheat	80,000	200,000	150.0
Barley	135,000	200,000	48.1
Vegetables	230,000	345,000	50.0
Fruits	120,000	150,000	25.0
Legumes&Oilseeds	15,000	21,000	40.0
Olives	95,000	85,000	-10.5
Meat	29,000	39,000	34.5
Milk	56,900	95,000	67.0
Eggs	4,900	8,100	65.3
Honey	29,000	164,000	465.6

Source: Libyan Arab Republic, Ministry Of Planning. The 3-year Economic and Social Development Plan. Op. Cit. pp. 179,182,187, and 188.

TABLE 2.8

**ACHIEVEMENTS IN AGRICULTURAL PRODUCTION,
DURING THE 3-YEAR DEVELOPMENT PLAN, 1973-1975.**

(In Tones)

Commodity	Production In 1972	Production In 1975	% Increase
Wheat	41,585,	107,000	157.3
Barley	116,395	216,000	85.6
Vegetables	382,195	620,000	62.2
Legumes & Oilseeds	18,658	24,000	28.6
Fruits	110.880	130,000	17.2
Olives	94,033	120,000	27.7
Meat	33,416	46,000	37.7
Milk	51,284	85,000	65.7
Eggs	2,975	9,000	202.5
Honey	93	350	276.3

Source: Libyan Arab Republic, Ministry of Planning, the 5- Year Economic & Social Transformation Plan, 1976-1980 (in Arabic), pp. 220, 232.

TABLE 2.9
PROPOSED AND ACHIEVED LAND RECLAMATION
IN THE 3-YEAR DEVELOPMENT PLAN, 1973-1975
(In Hectares)

Land Use Type	Proposed Area	Reclaimed Area	% Achieved
Development Areas	435,000	329,457	75.5
Field Crops, Vegetable, Fruits	160,000	115,307	72.1
Pasture & Afforestation	210,000	159,307	75.8
Cereal Cultivation in the Jefara Plain	65,000	159,180	84.6
Cultivated Areas	329,000	216,000	65.6
Irrigated Land	216,000	28,000	13.0
Dry-farming Land	216,000	98,000	45.4
Pasture Land	216,000	90,000	41.7

Source: 1-LibyanArabRepublic,MinistryOfPlanning.The3-yearEconomic&Social Development Plan, 1973-1975, op. cit., 221.
2- Libyan Arab Republic, Ministry of Planning. The 5-year Economic & Social Transformation plan, 1976-1980. Op. cit., pp. 220-221.

TABLE 2.10

**THE LONG-TERM DEVELOPMENT PROGRAMMES 1973-1985
AND THE ACHIEVEMENTS OF THE 3-YEAR PLAN, 1973-1975.**

Programme	Long-Term Target, 1973-85	Unit	Achievements of 1973-75	Percentage Achieved %
Sheep	260,800	No.	102,500	37.3
Cattle	12,700	No.	700	5.5
Poultry	1,000,000	No.	510,000	51.0
Beehives	28,400	No.	3,300	11.6
Productive Wells	3,485	No.	1,160	33.3
Farm units	12,411	No.	2,661	21.4
Main Roads	3,100	Km.	1,100	35.5
Secondary&DirtRoads	8,390	Km.	2,810	33.5
Training of Farmers	19,316	No.	3,580	18.5

Source: Libyan Arab Republic, Ministry of Planning, The 5-year Economic & Social Transformation Plan.1976-1980, Ibid. 220- 221 And 238.

TABLE 2.11

VOLUME OF AGRICULTURAL PRODUCTION BETWEEN

1975 AND 1980 (AT 1974 PRICES) (IN LD)

Commodity	Production in 1975	Projected production in 1980	% Increase between 1975-1980
Wheat	5,788,000	18,178,000	214.0
Barley	10,994,000	12,471,000	13.4
Vegetables	18,600,000	24,750,000	33.1
Fruits	10,400,000	20,400,000	96.1
Legumes & Oilseeds	3,600,000	6,300,000	75.0
Olives	5,100,000	6,300,000	12.5
Fodder Crops	24,357,000	52,576,000	115.7
Other Crops	1,600,000	2,800,000	75.0
Meat	36,800,000	78,400,000	113.0
Milk	5,100,000	17,400,000	241.0
Eggs	6,346,000	19,740,000	211.0
Wool	1,454,000	2,242,000	54.2
Hides	120,000	185,000	54.0
Honey	193,000	331,000	71.5
Increase in Animal Numbers	5,400,000	12,225,000 1,000,00	126.4
Forestry Production	600,000		66.7
TOTAL	136,452,000	275,298,000	101.8

Source: Compiled from: Libyan Arab Republic, Ministry of Planning, The Five-Year Transformation Plan, 1976-1980, Ibid. p. 188.

TABLE2. 12

PROGRAMMES AND ACHIEVEMENTS OF THE LONG-TERM PLAN FOR LAND RECLAMATION, 1973-1985

	Long-Term Programmes			Achieved During the 3-year Plan, 1973-1975			Proposed Programme For 5-year Plan 1976-1980			Proposed Programmes For, 1981-1985		
	Irrig.	Dry	Total	Irrig.	Dry	Total	Irrig.	Dry	Total	Irrig.	Dry	Total
Agriculture and Agrarian Reform	14,383	115,312	129,695	7,580	9,802	17,382	6,803	67,810	74,613	—	37,700	37,700
Integrated Agricultural Development	155,143	381,873	537,016	27,934	97,970	125,904	93,690	189,00	282,690	33,519	94,903	128,422
Total	169,526	497,185	666,711	35,514	107,772	143,286	100,493	256,810	357,303	33,519	132,603	166,122

Source: Libyan Arab Republic, Ministry of planning The 5-Year Transformation Plan, 1976-80., P. 190.

TABLE 2.13

LAND RECLAMATION FOR AGRICULTURAL DEVELOPMENT PROGRAMMES, 1976-1980
(IN 000 HECTARES)

CROP	1975		Total	1976		Total	1980		Total
	Irrig.	Dry		Irrig.	Dry		Irrig.	Dry	
Wheat	19	160	179	29	190	219	70	285	355
Barley	32	270	302	32	280	312	32	300	332
Vegetables	27	—	27	30	—	30	33	—	33
Fruits	17	33	50	18	35	53	22	28	50
Legumes & Oilseeds	15	—	15	16	—	16	20	—	20
Fodder Crops	40	13	53	55	16	71	72	35	107
Olives	16	65	81	16	70	86	17	90	107
Other Crops	2	10	12	2	11	13	2	20	22
TOTAL	168	551	719	198	602	800	268	808	1076

Source: Libyan Arab Republic, Ministry Of Planning. The 5-Year Transformation Plan. 1976-1980.op.cit. pp. 191-192.

TABLE 2.14

FOODSTUFF PRODUCTION, DEMAND, AND IMPORTS DURING THE 5-YEAR TRANSFORMATION PLAN 1976-1980
(IN TONS)

Commodity	1975			1976			1980		
	Produce	Demand	Imports	Production	Demand	Imports	Production	Demand	Imports
Wheat	100,000	351,000	251,000	149,000	376,000	227,000	303,000	410,000	107,000
%	28	100	72	40	100	60	74	100	26
Barley	216,000	40,000	—	224,000	40,000	—	245,000	30,000	—
%	100	—	—	100	—	—	100	—	—
Vegetables	620,000	630,000	10,000	670,000	670,000	—	825,000	825,000	—
%	98	100	2	100	—	—	100	—	—
Legumes	8,000	8,000	—	9,000	9,000	—	17,000	17,000	—
%	100	—	—	100	—	—	100	—	—
Fruits	130,000	190,000	60,000	141,000	205,000	64,000	255,000	276,000	21,000
%	68	100	32	69	100	31	92	100	8
Olives	23,000	43,000	20,000	25,000	47,000	22,000	37,000	69,000	32,000
%	53	100	47	53	100	47	54	100	46
Meat	46,000	75,000	29,000	52,000	82,000	30,000	98,000	128,000	30,000
%	62	100	38	63	100	37	77	100	23
Milk	85,000	160,000	75,000	99,000	185,000	86,000	290,000	29,000	—
%	53	100	47	54	100	46	100	—	—
Eggs	9,000	9,000	—	14,000	14,000	—	28,000	28,000	—
%	100	—	—	100	—	—	100	—	—

Source: Calculated from: Libyan Arab Republic, Ministry of Planning the 5- Year Transformation Plan, 1976-1980, op.cit.pp. 193-94.

TABLE 2.15

THE TARGETS FOR THE ANIMAL PRODUCTION DURING THE 5-YEAR
TRANSFORMATION PLAN, 1976-1980. (IN HEADS)

Animal	1975		1976		1980		% Increase Between 1976 and 1980
	Total	Milking	Total	Milking	Total	Milking	
Cattle Total	171,000	91,000	190,000	100,000	374,000	183,000	118.7
Public Sector	7,000	4,000	11,000	5,000	41,000	17,000	485.7
Private Sector	32,000	14,000	41,000	19,000	171,000	76,000	434.4
Local Breed	132,000	73,000	138,000	76,000	162,000	90,000	22.7
Sheep Total	2,885,000	54,000	3,190,000	600,000	4,420,000	820,000	53.2
Public Sector	2,700,000	540,000	2,970,000	600,000	4,100,000	820,000	51.6
Private Sector	185,000	—	20,000	—	320,000	—	73.0
Goats	950,000	475,000	900,000	450,000	700,000	350,000	-35.7
Camels	60,000	—	80,000	—	60,000	—	0.0
Rabbits	30,000	—	50,000	—	200,000	—	666.7

Source: Calculated from: Libyan Arab Republic, Ministry of Planning. The 5-Year Transformation Plan. Ibid. p. 197.

TABLE 2.16
THE TARGET FOR ANIMAL PRODUCTS IN THE
5-YEAR TRANSFORMATION PLAN, 1976-1980 (IN TONS)

% Increase				
Product	1975	1976	1980	1975-1980
Lamb	16,100	19,300	34,100	111.8
Beef	4,700	5,600	17,600	270.2
Poultry	11,100	11,600	26,000	134.2
Goat	4,700	4,500	3,500	-34.3
Camel	3,200	3,000	2,200	-45.5
Rabbit	300	500	2,00	566.7
Fat	6,000	6,700	12,800	113.3
TOTAL	46,100	51,500	98,200	113.0
Milk Cow's	56,600	71,000	259,000	357.6
Milk Sheep's	10,800	11,800	16,400	51.9
Milk Goat's	17,500	16,600	12,900	-35.7
TOTAL	84,900	99,400	288,300	239.6
Eggs	9,000	14,000	28,000	211.1
Wool	5,900	6,000	9,100	45.2
Hides	2,400	2,600	3,700	45.2
Honey	350	400	600	71.4

Source: Libyan Arab Republic, Ministry of Planning, The 5-Year Transformation Plan, 1976-1980, op.cit, p. 196.

TABLE 2.17

THE TARGET FOR POULTRY PRODUCTION DURING THE 5-YEAR TRANSFORMATION PLAN 1976-1980(IN Heads)

Poultry	1975	1976	1980	% Increase 1975-1980
Broilers Total	11,100,000	11,900,000	26,000,000	134.2
Public Sector	1,100,000	1,400,000	12,500,000	1036.4
Private Sector	10,000,000	10,500,000	13,500,000	35.0
Egg-Hens Total	1,800,000	2,400,000	3,900,000	166.7
Public Sector	300,000	600,000	900,000	200.0
Private Sector	1,500,000	1,800,000	3,000,000	100.0
Poultry Total	12,900,000	14,300,000	29,900,000	131.8
Public Sector	1,400,000	2,000,000	13,400,000	857.1
Private Sector	11,500,000	12,300,000	16,500,000	34.5

Source: Libyan Arab Republic, Ministry of Planning. The 5-year Transformation Plan, 1976-80.
Op.cit.p.199.

TABLE 2.18

THE TARGET FOR AGRICULTURAL PRODUCTION DURING THE 5-YEAR TRANSFORMATION PLAN,
1976-1980 (IN TONS)

CROP	1975	1976	1980	% Increase 1976-1980
Wheat	107,000	156,000	336,000	314
Barley	216,000	224,000	245,000	113
Vegetables	620,000	670,000	825,000	133
Fruits	130,000	140,000	255,000	196
Legumes	24,000	27,000	42,000	175
Olives	120,000	124,000	148,000	123
Fodder	616,000	889,000	1,321,000	214
Other	8,000	9,500	14,000	175

Source: Libyan Arab republic, Ministry of Planning. The 5-Year Transformation Plan. 1976-1980,
op. cit. p. 195

TABLE 2.19

AREAS FOR PROJECTS IN THE FIVE REGIONS, 1976-1980
(IN HECTARES)

Regions	Irrigated Areas	Unirrigated Areas	Total Area	No. of Farms
Crops Area				
Jefara plain Region	22898	90472	113370	4130
Jabal Al-Akhdar Region	25215	172599	197814	2604
Fazzan Region	27280	* —	27280	1733
Kufra & Es-Sarir Region	49900	—	49900	1364
As-Sulul Al-Khudur Region	29850	18802	48652	2788
Total crops Area	155143	281873	437016	12619
Pastures & Forests Area				
Jefara Plain region	—	288100	288100	—
Jabal Al-Akhdar region	—	334700	334700	—
As-Sulul Al-Khudur region	211,000	-	211000	—
Total Pastures & Forests area	—	833800	833800	—
Grains Area				
Grains sowing project	—	100000	100000	—
Total areas for development Programs	155143	1215673	1370816	12619

* Inexistent

Source: Libyan Arab Jamahiriya, Ministry of planning, Economic & Social Transformation Plan, 1976-1980, op. cit. p 219.

TABLE 2.20
MAIN PROGRAMMES IN AGRICULTURAL DEVELOPMENT ACTIVITIES 1976-1980

Region	Productive Wells	No. of Agric. Housing Units	Main Roads Length in Km	Rural Roads Length In Km	No. of Breeding trainee	No. of Sheep	No. of cows	No. of Poultry	No. of beehives
Jefara Plain	498	4247	996	3860	5322	13578	2850	219500	66500
Jabal Al-Akhdar	1205	2470	1732	1803	4240	78000	9392	200000	21500
Fazzan	578	954	133	188	954	750	300	—	—
Kufra & Es-Sarir	754	2064	99	751	4690	100,000	— [*]	—	—
As Sulul Al- Khudur	450	2676	141	1854	4110	68450	154	576000	200
Total agricultural development	3485	12411	3101	8386	19316	260778	12696	995500	28350

^{*} Data unavailable

Source: Quinquennial Transformation Plan 1976-1980, op. cit. p 232.

TABLE 2.21
EVOLUTION OF AGRICULTURAL PRODUCTION DURING THE PERIOD OF THE TRANSFORMATION PLAN, 1976-1980
 ("000") tons

Commodities	1975	Agricultural Production				
		1976 ⁽¹⁾	1977 ⁽¹⁾	1978 ⁽¹⁾	1979 ⁽²⁾	1980 ⁽³⁾
Wheat	75	130	57	99	110	141
Barley	192	196	59	196	100	71
Fruits & Olives	248	147	188	157	190	312
Vegetables	564	544	532	565	575	659
Legumes & oil seeds	19	21	20	20	20	12.6
Olive oil	18	17	8	24	16	15.5
Fodder	351	391	400	360	420	390
Meat	44.3	42	41	39	42	59
Dairy	87	93	80	87	80	110
Eggs	10.3	11	11	13	15	15.7
Honey	0.235	0.240	0.337	0.345	0.350	0.360

(1) Actual production,

(2) Expected production

(3) Assessed production

Source: The Economic and Social Transformation Plan 81-1985.op.cit. p. 3

TABLE 2.22

ALLOCATIONS FOR THE AGRICULTURAL TRANSFORMATION PLAN, 1976-1980 (In L.D.)

SECTOR	Original Allocation		Amended Allocation		% Increase 1975-76
	1975-76	%	1976-77	%	
Economic Plan	7,170,000,000	100.0	7,515,000,000	100.0	4.7
Agricultural Sector	1,226,596,000	17.1	1,270,029,000	16.6	3.5
Agriculture and Agrarian Reform Sector	445,296,000	36.3	412,269,000	32.5	-8.0
Integrated Agricultural Reform Sector	781,300,000	63.7	857,760,000	67.5	9.8

Source: Libyan Arab Republic. The Ministry of Planning. The 5-year Transformation Plan.
Ibid. P.200. El jihad Newspaper No. 1472. Dec. 30, 1976... op. cit., p. 11.

TABLE 2.23

ALLOCATIONS FOR AGRICULTURAL AND AGRARIAN REFORM DURING THE PLAN PERIOD, 1976-1980

(IN LD)

PROGRAMME	1976-80 (1)	% of Total	1976 (2)	1978 (3)
Land Reform	56,335,000	12.6	16,615,000	10,250,000
Pasture Land	14,000,000	3.1	1,810,000	3,300,000
Livestock	95,125,000	21.3	21,625,000	23,820,000
Crops	11,100,000	2.5	2,650,000	4,320,000
Dates	1,000,000	0.2	200,000	930,000
Forestry	14,100,000	3.2	3,250,000	4,200,000
Machinery	3,500,000	0.8	700,000	1,850,000
Extension	2,250,000	0.5	1,170,00	2,450,000
Stores & Silos	22,110,000	5.0	6,500,000	6,300,000
Agricultural Roads	20,000,000	4.5	4,000,000	11,500,000
Credit & Assistance	126,000,000	28.3	35,500,000	32,940,000
Statistics & Research	11,000,000	2.5	2,370,000	2,290,000
Hydrology Studies	24,276,000	5.5	7,846,000	—
Agricultural Training	8,500,000	2.0	26,000,000	4,050,000
Wadi Development	35,000	7.8	4,000,000	800,000
Public Agricultural Company. & Agri. Products	1,000,000	0.2	250,000	—
TOTAL	445,296,000	100.0	111,086,000	10,900,000

Source: (1).Libyan Arab Republic, Ministry of Planning, The 5-year transformation

Plan, op.cit.p.216

(2).Ibid.p.11

TABLE 2.24

THE TARGET FOR LAND RECLAMATION AND DEVELOPMENT IN THE INTEGRATED AGRICULTURAL DEVELOPMENT REGIONS, 1976-1980 (IN HECTARES)

REGIONS	Fruits Vegetables Cereals	%	Pasture & Forestry	%	Cereal Production	%	Total	%
Jefara Plain	65,330	21.5	230,180	35.1	45,030	100.0	340,540	33.9
Jabal Al-Akhdar	158,564	52.2	223,040	34.1	* —	—	381,604	38.1
Fazzan	19,465	6.4	* —	—	—	—	19,465	1.9
Kufra-Es-Sarir	25,600	8.4	—	—	—	—	25,600	2.6
Es-Sulul El-Khudur	34,750	11.5	201,400	30.8	—	—	236,150	23.5
TOTAL	303,709	100.0	654,620	100.0	45,030	100.0	1,003,359	100.0
% Of TOTAL	30.3	—	65.2	—	4.5	—	100.0	—

Source: Based on: Libyan Arab Republic, Ministry of Planning, and the 5-year Transformation Plan, Ibid-p. 223. (In Arabic).

* Unavailable

TABLE 2.25

THE LONG-TERM PLAN FOR LAND RECLAMATION AND DEVELOPMENT, 1973-1985. (IN HECTARES)

Project & Locale	Irrigated	Dry- Farming	Total	No. of Farms
Field Crops	157,543	281,878	439,421	* —
Jefara Plain	22,898	90,472	113,370	4,130
Jabal Al-Akhdar	25,215	172,599	197,814	2,604
Fazzan	27,280	—	27,280	1,733
Kufra-Sarir	49,900	—	49,900	1,364
Es-Sulul El-Khudur	29,850	18,802	48,652	2,788
Pasture & Forest	—	833,800	833,800	—
Jefara Plain	—	288,100	288,100	—
Jabal Al-Akhdar	—	344,700	334,700	—
Es-Sulul El-Khudur	—	211,000	211,000	—
Cereal Production	—	100,000	100,000	—
Jefara Plain	—	100,000	100,000	—
Maknusah Project	2,400	—	2,400	—
Total	157,543	1,215,673	1,373,216	12,619

Source:Libyan Arab Republic, Ministry of Planning. The 5-year Transformation Plan

.p.219 (In Arabic)

*Unavailable.

TABLE 2.26

THE MAIN PROGRAMMES IN THE INTEGRATED AGRICULTURAL DEVELOPMENT PLAN, DURING THE 5-YEAR
TRANSFORMATION PLAN, 1976-1980(In. Number)

Programme Location	Productive Wells	Farm- House	Main Roads Km.	Unpaved & Dirt Roads	Trainees	Sheep	Cattle	Poultry	Beehives
Jefara Plain	498	4,247	996	3,860	5,322	13,578	2,850	219,500	6,650
Jabal Al- Akhdar	1,202	2,470	1,803	1,803	4,240	7,800	9,392	2,000,000	21,500
Fazzan	578	954	133	118	954	750	300	—	—
Kufra-Es-Sarir	754	2,064	99	751	4,690	100,000	—	—	—
Es-Sulul El- Khudur	450	2,676	141	1,854	4,110	68,450	68,450	576,00	200
TOTAL	3,485	12,411	3,101	8,386	19,316	260,778	12,696	995,500	28,350

Source: Libyan Arab Republic, Ministry of Planning. The 5-year Transformation Plan. Op.cit. p. 23

TABLE 2.27

THE TARGETS AND ACHIEVEMENTS FOR INTEGRATED AGRICULTURAL DEVELOPMENT IN PUBLIC SERVICES

1976-1980 (IN LD Thousand)

ITEM	Plan's Target 1976-80	Existed In(1) 1975	Achieved in 1975-77(2)	Total Achieved 1975-77	% Of Plan
Wells	2,325	1,160	606	1,766	76.0
Asphalted Main Roads km and	2,000	1,100	592	1,692	84.6
Unpaved Roads, km.	5,580	2,810	4,721	7,531	168.0
Farm-houses	9,750	2,661	3,237	5,898	54.9
Farmer's Trainees	15,740	3,580	4,129	7,709	53.7

Source: (1) Libyan Arab Republic, Ministry of planning. The 5-Year Transformation Plan ,op.cit. pp. 221 & 224.

(2) El-Fajir El-Jadid, Newspaper. No. 1700 Feb.11, 1997 Tripoli – Libya. p.7 (In Arabic).

TABLE 2.28
ALLOCATIONS FOR THE INTEGRATED AGRICULTURAL DEVELOPMENT PROGRAMME 1976-80 (INLD)

PROGRAMME	1976-80	% Of Total	1976
Jefara Plain	219,900,000	28.2	53,940,000
Jabal Al-Akhdar	195,300,000	25.0	37,900,000
Fazzan	115,000,000	14.7	23,500,000
Kufra-As-Sarir	133,000,000	17.0	29,000,000
Es-Sulul El-Khudur	95,600,000	12.2	16,750,000
Cereal Production	20,000,000	2.6	4,000,000
Agricultural Co.	2,500,000	0.3	750,000
TOTAL	781,300,000	100.0	165,840,000

Source: (1). Libyan Arab Republic, Ministry of Planning. The 5-Year Transformation Plan, 1976-1980.op.cit. p. 225.
(2). El Fajir El Jadid Newspaper, No. 1418. Ibid. p. 2. Detailed allocations for 1977 are not available.

TABLE 2.29

ALLOCATIONS AND THEIR AMENDMENTS FOR THE AGRICULTURAL SECTOR, 1976-80 (INLD)

SECTOR	1 st Allocation	Amended Allocations 1976-1980 (2)	Allocations For 1976 (1)	Allocations For 1977 (3)	Allocations For 1978
Agriculture & Agrarian Reform	445,296,000	412,269,00	111,086,000	107,100,000	109,000,000
Integrated Agric. Development	781,300,000	857,760,000	165,840,000	176,000,000	227,600,000
Agriculture Sector	1,226,596,00	1,270,029,000	276,926,000	283,100,000	336,600,000

Source: (1). Libyan Arab Republic, Ministry of Planning. The 5-year Transformation Plan, 1976-1980.op.cit. pp.216 & 225.(In Arabic).

(2). El-Fajir El-Jadid Newspaper, No. 1427, Dec. 30, 1977 Tripoli –Libya. p. 11 (In Arabic).

(3). IBID. p. 4.

(4). El-Fajir El-Jadid Newspaper, No. 1418 op. cit. p. 2.

TABLE 2.30

ACHIEVEMENTS IN LAND RECLAMATION FOR THE INTEGRATED AGRICULTURAL DEVELOPMENT PROGRAMME

1976-80(IN HECTARES)

Reclamation Area	Target 1976-80 (1)	Existing In 1975 (2)	Achieved In 1975-76	Total Achieved In 1976-77 (3)	% of Target
Crops, Vegt. Fruits	303,709	115,307	71,125	186,432	61.4
Pasture & Forestry	654,620	159,180	226,032	385,212	58.8
Cereal Production	45,030	54,970	34,944	98,914	219.7
TOTAL	1,003,359	329,457	341,101	670,558	66.8

Source: (1). Libyan Arab Republic, ministry of Planning. The 5-year Transformation Plan, op.cit, p. 222.

(2). IBID. p. 220.

(3). El-Fajir El-Jadid, Newspaper, No.1699; Feb. 9, 1978 Tripoli – Libya p. 7 (In Arabic).

TABLE 2.31

ACHIEVEMENTS IN FRUIT AND FOREST TREES PLANTED DURING 1976-1977 FOR THE INTEGRATED
AGRICULTURAL DEVELOPMENT PROGRAMME, 1976-1977

Project	NO. of Fruit Trees	% of Total	No. of Forest Trees	% of Total
Jefara Plain	5,304,105	27.8	54,714,879	60.9
Jabal El-Akhdar	5,909,852	31.1	13,926,606	15.5
Fazzan	815,774	4.3	3,393,695	3.8
Kufra-As-Sarir	290,185	1.5	36,137	0.1
Es-Sulul El-Khudur	6,710,178	35.3	17,725,744	19.7
TOTAL	19,030,167	100.0	89,796,961	100.0

Source: (1). El Fajir El Jadid, No. 1966.op.cit. p. 7.

(2). Libyan Arab Republic, Council for Agricultural Development, With the March
of the Integrated Agricultural Development. Oct., 1976 (In Arabic) Tripoli- Libya, pp. 10-12 and 19-9

TABLE 2.32

ACHIEVEMENTS IN AGRICULTURAL PRODUCTION AND ANIMAL PRODUCTS IN THE INTEGRATED AGRICULTURAL
DEVELOPMENT PROGRAMME, 1976-1977.

CROP PRODUCTION	1976	UNIT	1977	UNIT	+,- %
Wheat	216,422	Tons	204,526	Tons	-5.8
Barley	117,319	Tons	133,200	Tons	-3.6
Vegetables	586,00	Tons	803,000	Tons	37.0
Fruits	780	Tons	1,500	Tons	92.3
ANIMAL BREEDING					
Sheep	29,245	Heads	22,879	Heads	-27.8
Cattle	240	Heads	260	Heads	8.3
Camels	1,013	Heads	144	Heads	-603.5
Poultry	217,117	Heads	159,640	Bird	-36.0
ANIMAL PRODUCTS					
Milk	357,839	Litres	510,389	Litres	42.6
Eggs	3,865,342	Dozens	3,602,765	Dozens	-7.3
Wool	12,701	Tons	11,320	Tons	-12.0
Honey	467	Tons	579	Tons	24.0

Source: (1). Figures for 1976, calculated from: Libyan Arab Republic, Council for
Agricultural Development; With The March of the Integrated Agricultural
Development of 1976. op. cit. pp. 10-11.

(2). El Jihad, No. 1427- op. cit. p. 5.

TABLE 2.33

DEVELOPMENT OF AGRICULTURAL PRODUCTION(IN THOUSAND TONS) DURING THE TRANSFORMATION PLAN
1981-1985 AND CONTRIBUTION TO SELF-SUFFICIENCY

Product	1980					1985			
	Produced	Needs	Imports	% Self-Sufficiency		Produced	Needs	Imports	% Self-Sufficiency
Wheat	140.5	410	296.5	34.3		428.8	580	141.2	75.3
Barley	71.5	71.5	— [*]	—		105.6	105.6	—	100
Vegetables	658.3	688.4	30.1	95.6		779	815	36	65.6
Fruits & Olives	312	318	6	98.1		344	352	8	98
Legumes & Almonds	122.6	29.6	17	42.6		12	58	46	20.7
Meats	58.6	128	69.4	45.8		130.4	45.3	45.3	75.8
Fishes	8	11.7	3.7	68.4		20	26	6	77
Eggs	15.7	15.7	—	100		45.3	45.3	-	100
Milks & Dairy Products	110	225.1	115.1	48.9		308	325	17	94.8

* - Unavailable

Source: Economic & Social Transformation Plan 81-1985, op. cit. p 16.

TABLE 2.34

OBJECTIVES OF THE LAND RECLAMATION AND DEVELOPMENT PROGRAMME ACCORDING TO THE ECONOMIC
AND SOCIAL TRANSFORMATION PLAN 1981-1985

Area Programme	Total Programme			Total Executed by 1980			Objectives of Transformation Plan 1981-1985		
	Irrigated	Unirrigated	Total	Irrigated	Unirrigated	Total	Irrigated	Unirrigated	Total
Jefara Plain Region	22632	305908	328540	18321	198185	216506	431	107723	112034
Jabal Al-Akhdar Region	13710	725749	739459	5950	302344	308294	7760	423405	431165
As-Sulul Al-Khudur Region	18016	51440	69456	3698	29989	33687	14318	21451	35769
Fazzan Area	34672	*	34672	16745	—	16745	17927	—	17927
Kufra & Es-Sarir Region	32350	—	32350	27364	—	27364	4986	—	4986
Reclamation & Plantation Project	37467	—	37467	27680	—	27680	9787	—	9787
Water Transformation Programme	50000	—	50000	—	—	—	10000	—	1000
Total	208847	1083097	1291944	99758	530518	630276	69089	552579	621668

Source: Economical & Social Transformation Plan 1981-1985 op. cit. p. 24.

*-. Unavailable

TABLE 2.35
AREAS AND EXPECTED PRODUCTION FOR THE FIRST YEAR OF THE TRANSFORMATION PLAN, 1981-1985.

Area	Summer Season		Fall Winter/Spring Season		Greenhouses	
	Area Hectare	Production Tone	Area Hectare	Production Ton	Area Hectare	Production Ton
Coastal Strip	3508	103330	9580	137052	380	49000
Eastern Areas	3947	136360	3498	34162	219	27950
Southern Areas	2062	54340	3448	50473	*	-
Es-Sarir Project	-	-	3720	154320	-	-
Central Area	750	26250	-	-	50	6100
Participation of Public Production Projects	-	-	3720	154320	649	83050
Private Sector Participation	11267	320280	16526	221687	-	-
Total	20784	640560	40492	376007	1298	166100

Source: Economic and Social Transformation Plan, 81-1985, op. cit. p. 30.
 * Not available.

TABLE 2.36

ACHIEVEMENTS AND TARGETS OF THE FORESTRY DEVELOPMENT PROGRAMME

1976-1980-1981-1985

Year	Transformation Plan 1976-1980		Transformation Plan 1981=1985		Notes
Statement	Achieved land (Afforestation)	Number of sets distributed	Area afforested	Production of sets	
Afforestation 1976-80	98298	257692321	165405	12161000	Every year about 53081 hectares are afforested and the lack of sets is covered by the new ones
Wind breaks 76-1979	42971	257692321	63443	187839000	Every year about 33081 hectares are afforested and 12688 hectares are covered by windbreaks
Estimated during 1980	45000	65000000		312161000	
Afforestation 76-1980	98298	257692321	165405	18739000	
Wind breaks 76-1979	42971	257692321	63443		
Estimated during 1980	45000	65000000			
Total	186269	322693321	228848	500.000.00	

Source: Economic and Social Transformation Plan 1981-1985.op.cit.p.35

Table 2.37

**AGRICULTURAL AND ANIMAL PRODUCTION DURING THE
PERIOD 1970-1985.**

Commodity	1970 (Tons)	1985 (Tons)	Absolute increase	Ann. Compound Rates of develop.
Wheat	27.2	210	182.8	14.6%
Barley	52.8	105	52.2	4.7
Legumes & Seeds	13.7	12	—	—
Vegetables	205.2	827.5	622.3	9.7
Fruits	90.3	280.0	189.7	7.8
Olives	69.2	145.0	75.8	5.1
Meat	42.14	94.0	51.7	5.5
Dairy	52.4	150.5	98.1	7.3
Honey	30	500	470	—
Eggs (in millions)	45.5	554.5	509	18

Source: The March of Construction and Transformation, op. cit. p. 17.

TABLE 2.38
THE MOST IMPORTANT ELEMENTS REALIZED IN THE
AGRICULTURAL SECTOR DURING THE PERIOD 1970-1985

Items	Unit	Total fulfilment
Wells	Well	3031
Cisterns and Water Reservoirs	Cist. /Res.	360
Fruitful Trees	Trees	27,271,043
Forest and Wind-Breaks Trees & Pasture	Tree	207,156,786
Grain Silos	Silo	32
Grain Storages	Storage	80
Distributed Farms to Farmers	Farm	11314
FarmHouses	House	11804
Paved Agricultural Roads	Km.	2721km
Dirt Agricultural Roads	Km.	15083km
Agricultural Cooperative Societies	Society	350
Graduates From Agricultural Institutes	Graduate	3507
GreenHouses	Greenhouse	197
Beehives	Hive	2661
Tractors Distributed to Farms	Tractor	7422
Ploughs Distributed to Farms	Bloug	11260
Drags Distributed to Farms	Drag	6149
Sowing Tractors Distributed to Farms	Sower	1847
Trainees		10842

Source: The Building and Constructing March. Op. cit. p. 18.

TABLE 39
EVOLUTION OF THE AVERAGE PER CAPITA INCOME IN G.N.P,
DURING THE PERIOD, 1970-1985.

Year	GNP at constant factor cost in million	Size of population in the mid-year (thousand)	Per capita incomes (LD)	Per capita income (\$)
1970	1288.3	2006.0	642	1798
1975	3674.3	2683.1	1369	4632
1980	10237.2	3245.8	3154	10654
1985	7540.3	3668.4	2055	6943
Expected	12.5	4.1	8.1	—
Compound rate, of annual. Increment 1970,1985				

Source: The march of Building & Transforming op. cit. p. 12.

CHAPTER THREE

AN ECONOMIC ANALYSIS OF AGRICULTURAL DEVELOPMENT

3.1 Introduction

The search for a general theory of economic development has received the attention of economists for well over two centuries. In explaining economic growth and development, some of the resulting theories have involved formal economic models, whilst others have provided logical descriptions of the stages or structural changes that countries tend to experience. A significant bulk of contributions in this area were developed in the late eighteenth and early nineteenth centuries by classical economists such as Smith, Mill, Malthus and Ricardo. Given the prime position of agriculture, most of the examples such economists cite relate to agricultural prosperity and development.

3.2 The Classical Model

In its simplest form, classical theory proceeds with two broad types of agents: workers whose only asset is their labour, and capitalists who own land and capital. The conventional wisdom is that given a certain amount of labour, wages are paid just enough to cover workers' subsistence. Under this system if a new technology or invention leads to an increase in production, a surplus is generated which is then accumulated by capitalists. Such accumulation increases the demand for labour, and in the short run nominal wages tend to rise. As wages exceed the level of subsistence, the population grows, generating a rise in the demand for food. However, if high quality land is fixed in the short run, the rise in food demand is met by bringing lower

quality land into production. The price of food rises to cover the higher cost of production on lower quality land. The effects of increased population (labour supply) and higher priced food drive real wages back down to the subsistence level, causing a decline in the rate of population growth.

Thus, in the classical model, diminishing returns to labour applied to a relatively fixed supply of high quality land and higher costs of production on lower quality land represent a constraint on growth so that living standards remain at subsistence levels if technological progress occurs, the situation may change temporarily but not permanently. This type of analysis has been mathematically illustrated and presented by neo-classical economists using marginal theory. In short, labour market equilibrium occurs when the marginal productivity of labour becomes equal to the real wage rate, representing the maximum economic surplus accruing to capitalists. Given the marginalist approach, any new technology or invention, within agricultural activity can only increase overall labour productivity, which brings about extra surpluses for land-owners.

History has shown that the classical model underestimates the role of technological progress. It also fails to consider factors that tend to lower birth rates as economic growth occurs. It further oversimplifies the forces influencing wages and the complexity of the sharing or distributive objectives found in many societies. Nevertheless, certain aspects of the classical model have had a marked influence on subsequent theories of economic development.

3.3 Growth Stage Theories

A second approach to economic development has been to break down the growth process into successive stages through which countries must pass as they develop. While the stages suggested have been based on different principles, most theorists have emphasised that economic development involves significant transformations in the social, political and economic infrastructure of a country.

In the nineteenth century, Fredrick List, a German economic historian, developed a set of stages based on shifts in occupational distribution. His well-known five stages were (i) savagery, (ii) pastoralism, (iii) agriculture, (iv) agriculture-manufacturing, and (v) agriculture-manufacturing-commerce. List believed that progress in agriculture was dependent on strong export demand or domestic industrial development. He argued that the latter had the most potential as a source of agricultural and total economic growth. He proposed import substitution policies to protect infant domestic industries so that they could grow and replace what otherwise might be imported. This proposition has appealed to many politicians and industrialists in many developing countries but has been controversial amongst economists and the promoters of free trade.

Another nineteenth century German, Karl Marx, visualised six stages of development based on changes in technology, property rights and ideology. His steps were (i) primitive communism, (ii) ancient slavery, (iii) medieval feudalism, (iv) industrial capitalism, (v) socialism, and (vi) communism. His analysis is based on the class struggles, which drive countries through these stages. One class possesses the land, capital and authority, while the other possesses only labour. Class struggles become imminent as economic institutions allow the exploitation of labour. Prior to reaching

the final stage, labour is never paid its full value. Marx's ideas received the most attention in the early 20th century in those developing countries where economic divisions amongst classes were extremely significant. Aside from ideological considerations, his writings are of contemporary interest because of the role he attached to technological progress in influencing economic institutions. Moreover, he viewed economies of scale in both agriculture and industry as major sources of growth (Hayami and Ruttan, 1985).

The concept of growth stages re-emerged between the 1930s and 1950s when Alan Fisher and Colin Clark developed a theory with three stages of growth. In Clark's formulation, agriculture is dominant in the first stage, manufacturing grows relative to agriculture in the second, and service industries grow the fastest in the third stage. Economic growth is achieved by increases in labour productivity in any sector and by the transfer of labour from the less productive sectors to more highly productive sectors. Fisher linked the transitions between stages to advances in science and technology (Norton and Alwang, 1993).

One of the major contributions made in this area relates to the theory developed by Rostow during the 1950s. He identified five stages through which all countries must pass: (i) transitional society, (ii) pre take-off, (iii) take-off, (iv) technological maturity and (v) mass consumption. He felt that deceleration of the rate of growth in sectoral production is a normal path for any sector: capital accumulation and technological changes bring about such transformations. In other words, declining prices and the income elasticities of demand eventually dampen growth rates of the leading sectors, transforming them into declining sectors (Rostow, 1960).

During the 1950s, economists and politicians became enamoured of the growth model developed by Harrod and Domar. The Harrod-Domar model postulates that the rate of growth of national income is positively related to the national savings ratio, and negatively to the nation's capital-labour ratio. In other words, in order to grow, a country must save and invest simultaneously, but the rate at which it grows for any given level of savings and investment depends upon how productive that investment is, which in turn can be measured by the inverse of the capital/output ratio. Whilst the Harrod-Domar model correctly identifies capital accumulation as a potential source of growth, it does neglect other important elements of the development process. This led some policy-makers in certain developing countries, such as in India in the 1950s and 1960s, to place heavy reliance on capital intensive industrial growth while the need for mobilising labour and improving agriculture was neglected.

3.4. More Recent Development Models

In the 1950s and 1960s, economists moved from whole economy, one-sector development models to two-sector models. One of the major contributions made in this area is associated with the pioneering work of Solow (1956, 1957) on growth theory. Primarily based on production functions and labour productivity as a means of growth, he argued that both savings and capital-labour ratios should be regarded as the main determinants of growth. In Solow's model, however, technological change embodied within the production function plays an important role in growth determination. In short, the Solow model of growth modifies the Harrod-Domar model but adds technology as an exogenous factor in explaining long-term growth (Todaro and Smith, 2003, 130-37).

The poor performance of neoclassical theories in explaining the sources of long term economic growth has led to a widespread dissatisfaction with traditional economic theory and to the conclusion that there are no intrinsic characteristics of economies that cause continuous growth. In the absence of external shocks or technological change, which are not covered by neoclassical models, all economies will converge to zero growth. Hence, rising per capita GNP appears to be a temporary phenomenon resulting from a change in technology, or a short run process in which an economy approaches its long run equilibrium. The body of theory, therefore, fails to provide a satisfactory explanation for the rather consistent pace of historical growth in economies around the globe.

The free-market reforms presented to highly indebted economies by the World Bank and IMF have prompted rather limited success, since the LDCs experienced little or no growth and failed to attract new foreign investment or to stop domestic capital flight. These observations have led to the development of the concepts of *endogenous growth* theory, supported by a significant number of eminent economists across the world. In contrast to traditional neoclassical theory, the advocates of this theory hold GNP growth to be a natural consequence of long run equilibrium, and hence explain both growth rate differentials between countries and the greater proportion of growth observed. The most significant theoretical differences stem from discarding the neoclassical assumption of diminishing marginal returns to capital investment, permitting increasing returns to scale in total production and focusing on the role of externalities in determining the rate of return on capital investment.

Perhaps the most striking aspect of endogenous growth models is that they help explain anomalous international flows of capital that exacerbate wealth disparities between developed and developing nations. The potentially high rates of return on Investment offered by developing economies coupled with low capital-labour ratios are greatly exhausted by lower levels of complementary investment in human capital, social and political infrastructure, and in research and development (Barro, 1990; Romer, 1994). A significant part of such complementary investments is envisaged to be provided by government. It can therefore be argued that, unlike the Solow model, new growth theory models explain technological change as an endogenous outcome of both public and private investments in human capital and knowledge-intensive industries (Tadaro and Smith, 2003, 148).

In short, the new growth models provide new insight in to fundamental issues facing developing countries, going beyond the rather mechanical tools and instruments proposed by the neoclassical economists. In particular, this approach leads to a concentration upon specific infrastructural foundations of a given economy prior to the examination of its economic indicators. This process of thinking has led economists and policy-makers to deviate slightly from theory in the search for alternative strategies open to developing economies.

3.5. Alternative Strategies: The Role of Agriculture

The question of the extent to which resources should be channelled into agriculture and industry has puzzled policy makers for decades. In most developing countries agriculture is initially the dominant sector containing most of the resources. However, in other economies primary oil and mineral products are major resources to

be exploited. As growth occurs, according to the so-called *Dutch Disease* phenomenon, one sector may decline and another may take the lead (see, Cordon & Neary, 1982; Matsuyama, 1992; Sacks & Warner, 1995; and Torvik, 2002). Many countries have found it fruitful to invest in productivity-enhancing agricultural technologies in the early and middle stages of development because that is where the natural resources tend to be concentrated, and because food is a major item in the consumer budget. Once development reaches a certain point, the relative importance of agriculture declines as food consumption's share of total consumption drops significantly.

Nevertheless, for most developing countries, agricultural development matters for overall economic development. Prior to the 1960s, development strategies emphasised capital-intensive industrial growth. For a period in the 1970s, concern that agricultural development would skew income away from small scale farmers and tenants led to calls for integrated rural development projects. Unfortunately, these projects tended to be complex, mostly lacked integration with national support structures, frequently diverted personnel and other resources away from broad-based economic development, and ignored the need for more fundamental institutional changes. It is now generally agreed that agricultural development is spurred in part by education and training, the adoption of new technologies, and institutional improvements which can help stimulate broad-based economic development (Mellor, 1976). Such developed agricultural sectors provide food, supply labour for industry, directly and indirectly generate capital, and provide a market for non-agricultural goods-based services. Under these circumstances, agricultural development can potentially provide a direct increase in rural welfare.

Some alternative strategies and theories that have been applied and proven to be fruitful may be offered as follows

3.5.1. Resource Exploitation and Conservation Theory

One potentially useful means of generating increased agricultural production is to expand the use of labour and land. The opening up of forests and jungles by local populations in Africa, Latin America and Asia provide examples of expanded resource use. In many of these cases, surplus land and labour were used to produce commodities for both local consumption and export. It is now proven that the expansion of unutilised land resources provides some opportunities for substantial growth in developing countries today. Abundant labour is available in many developing countries and the continued growth of the labour force generates increases in total agricultural output. However, most growth in per capita agricultural output will have to come from more intensive use of existing resources. Many methods of conservation have been proven positive and working (see Hayami and Ruttan, 1985, pp.52-54).

3.5.2. Theory of Location and Diffusion

This theory was first developed by von Thunen (1783-1850) who recognised that the pattern and intensity of agricultural production vary in relation to the proximity of urban-industrial centres and to the quantity and quality of transportation systems (Dickinson, 1969). One implication of this theory is that countries should encourage decentralised industrial development, particularly in the middle and late stages of development. During these stages, strong linkages between agriculture and markets for inputs (fertilisers and pesticides) and outputs can help stimulate the local economy. This therefore boils down to one critical issue: the improved transportation

infrastructure in rural areas. Diffusion theory stresses the importance of linkages amongst farmers themselves, with the basic idea that transfers of existing technologies from the more progressive to lagging farmers could increase productivity.

By the same token, diffusion theory proposes the transfer of knowledge and technologies from more developed to less-developed economies in emancipating international productivity. However, though knowledge has been transferred more freely from one nation to another, technological transfer has been rather more limited.

3.5.3. Theory of Induced Innovation

This theory attempts to explain the mechanism by which a society chooses an optimal path of technical change and institutional change in agriculture (Hicks, 1932). The theory postulates that technical change in agriculture represents a response to changes in resource endowments and to growth in product demand. In effect, a rise in the price of one factor relative to others will induce technical change that reduces the use of that factor relative to others. For example, if the price of land goes up relative to labour and fertilisers, indicating that land is becoming relatively scarce, technologies such as improved seeds will be developed that can be combined with labour and fertilisers to increase production per unit of land.

This theory encompasses the role of induced institutional change in developing and coping with new technology. There are many types of institutions that affect technical change and agricultural development. The rights to land, marketing systems, government pricing and credit policies, and laws governing contracts are just a few of these. The theory recognises that institutions can become obsolete and in

need of adjustment over time. In short, it argues that new technologies and changes in relative resource endowments or price changes provide incentives for a society to demand new institutional arrangements (Kilkuchi and Hayami, 1980).

3.5.4. Agricultural Reform/Land Reform Programmes

Agricultural reform refers collectively to those economic policies whose aims are primarily to increase productivity without changing the status of ownership. Land reform, however, is defined as the redistribution of land or associated rights in land, such as from large holdings to smaller holdings (Parvin & Taghavi, 1988). If land reform and agricultural reform are undertaken simultaneously, the process is usually called a land reform programme, entailing redistribution and support for an increase in productivity. In general land reform may diminish the political power of landlords, or may transform them into members of modern merchant or capitalist classes with new bases of power; by contrast, agricultural reform may enhance existing power relations. In effect, apart from growth and equity concerns, land reform is needed for political and economic stabilisation, and in helping to facilitate economic development.

Historically, land reforms have most often been made possible only after significant social upheavals caused by revolution, the overthrow of colonial powers, or war. For example, the extreme economic and political turmoil of the 1970s in China and in the 1980s and 1990s in the Soviet Union and Eastern Europe created the conditions for land reform in those countries. In capitalist countries such as Japan, South Korea and Taiwan, defeats in war or occupation were followed by re-distributive reforms (Bell, 1990). As for developing economies, land reforms have generally been unsuccessful

in delivering the right mix of equity and efficiency, primarily due to the inadequacy of infrastructure and poor public management.

3.5.5. Land Settlement

The aim of land settlement is primarily based on improved equity in the short run, with enhancing efficiency in the long run. This type of option has been primarily designed by Arab Middle East policymakers in attracting a large part of the nomadic population into farming. Under this strategy, the government allocates a large fertile piece of land to nomads who are prepared to enter into farming activity. Seeds, fertilisers, loans and all other training and technical supports are provided to these farmers free of charge over a certain period of time. In return, the new farmers normally enter in a contract with the government, agreeing to remain in farming activity for a specified period of time.

Although this may not have been exercised in Libya, land settlement has been used in some Arab countries as a political tool in controlling nomadic populations. If managed carefully, however, this option may enhance the standard of living of the nomadic population and lead to improved efficiency in farming. Further analysis relating to land settlement will be discussed in preceding chapters.

3.6. Summary and Conclusions

The potential contributions of various models of growth and development reviewed in this chapter have been examined to provide a better understanding of the causes and effects arriving from different strategies. The new approaches to development offered by the new growth analysts point out more clearly the real potential

Contributions of external factors in assisting the development process, beyond the provision of capital to modelling new ways of doing things. Social and political infrastructures have been identified as major sources of success or failure in economic development.

As for the role of agriculture in economic development, a number of theories and strategies along with their respective strengths and limitations were examined. As far as the developing nations are concerned, the major task in alleviating agricultural development is not necessarily related to capital accumulation; rather it is related to more fundamental issues arising from cultural and social phenomena.

CHAPTER FOUR

COST-BENEFIT ANALYSIS: THEORY AND APPLICATIONS

4.1 Introduction

As discussed earlier, the land settlement projects introduced in Libya over the period 1970-1985 were primarily aimed to improve economic conditions of a large number of farming communities and to settle a significant number of nomadic tribes and herdsmen. In effect, it was an economic development plan aiming to improve the agricultural productivity and output. To this end, chapter three was dedicated to a detailed analysis of economic development theory with a special reference to agricultural development strategies. Since the projects in Libya were fully implemented and financed by the government, it is also necessary to analyse these projects from cost-benefit analysis point of view. For this reason, this chapter is designed to highlight the main framework of cost-benefit analysis, its problems, its limitations, and its ways of measuring the extent of failure/success of a given project.

In part 4.2, a theoretical overview of the cost benefit analysis is offered. In an attempt to identify the rationale behind CBA, part 4.3 examines the efficiency and equity aspects derived from the application of CBA. Part 4.4 examines the technical tools required for CBA. Part 4.5 examines the Jefara Plain case study in consideration of the CBA technique. Finally, part 4.6 concludes this chapter.

4.2 CBA: An Overview of the Literature

As society has evolved, it has become more complex, seemingly at an increasing pace. This complexity affects aspects of society and has special relevance for environmental decision-making. Not only are citizens re-evaluating the services they expect from the environment and concomitantly increasing their willingness to sacrifice other consumption in favour of enhanced environmental services, but the character of environmental issues is becoming more complex as well. It is believed that incomplete information, uncertainty, system-wide change, trans-frontier impacts, current causes that have far reaching future effects, irreversibilities, and possibilities of catastrophic change all complicate the environmental decision making process.

Decision makers are left with the awkward problem of evaluating potential outcomes and choosing policies to achieve these outcomes in the presence of this intense complexity. Decisions that are well intended can lead to losses in social welfare as unexpected outcomes develop, or as outcomes have unexpected consequences. Decision makers therefore have a great need for a framework which structures information in a way that makes the complexity more tractable, but still takes into account the implications of the complexity. Cost-benefit analysis is an analytical tool, which has the potential to significantly advance this process.

At the same time that society has become increasingly complex, we have entered a political era when the social benefits of governmental activities are increasingly questioned. As we have experienced an increase in the unintended outcomes and unexpected consequences resulting from public policy, there has been an increasing call from many quarters to subject all government programmes to an examination by cost-benefit analysis, because this provides a means of comparing complex projects,

even when benefits and costs occur during different time periods. It can, for example, be applied to many difficult issues now facing the local/national government. Should we spend on development of new transport networks, or should we spend the money fixing the combined sewer outflow in our large cities, or neither? Should we prohibit logging in old growth forests? Should we spend more money on research and development for cleaner cars or should we spend the money on mass transit? Should the Endangered Species Act be renewed? Cost-benefit analysis provides a means for systematically comparing the value of outcomes with the value of resources achieving the outcomes required.

Similar questions apply to state and local decision makers. Is economic development money best spent providing economic benefits and tax relief to firms who locate in the area? Or, should the money be spent on improving the average citizen's quality of life (improved environment quality, parks, river front improvement, improved educational systems, etc.) which would improve not only the well-being of current citizens, but could also influence industrial location? Should a motor car pooling programme be established to reduce pollution emissions and congestion? Should a particular area be developed as an industrial park, or maintained as a natural habitat?

Cost-benefit analysis has evolved to answer these and other issues of public policy. It provides a systematic means to enumerate all benefits and all costs, much like a private sector investment analysis. But because it deals with concerns of public policy, it must consider classes of benefits and costs that are more far reaching than a business decision focusing only on net profits.

Under a social CBA, all benefits and costs should be included, consisting of private and social, direct and indirect and, tangible and intangible. Therefore, these benefits and costs are within the framework of principles of welfare economics: benefits are based on the consumer's willingness to pay for the given project; costs are what the losers are willing to receive as compensation for giving up the resources. In effect, all these benefits and costs can be measured on the principle of *revealed preference* and willingness to pay.

The concept of revealed preference not only measures how much the recipients are willing to pay in total for a service received, but it also attempts to identify the contributions made by each factor in working in this total – the shadow prices. If there already exists a market for the new service, then the true prices are already there, so that the shadow prices match the true prices. However, in most cases, such markets may not exist, and then shadow prices are good approximations of what the true markets could offer.

As in relation to the third question, a suitable social discount rate, which should include the preferences of future generations, is to be used for discounting the periodic net benefit stream. The choice of this social discount rate is therefore associated with the concept of time preference, which tends to vary under different projects and different environment.

4.3 The Rationale Underlying Cost-Benefit Analysis

The neo-classical economic theory is founded on the notion of a rational individual, who makes decisions on the basis of a comparison of benefits and costs associated

with any activity. In this process, therefore, any intervention, whether physical or regulatory, would lead to inefficiency and seriously damage the individual decision-making. However, in the case of market failure – either due to externality or imperfect competition – it has been anticipated that some form of intervention would be necessary to correct the market mechanism. In correcting markets and adjusting for social welfare/distribution, several methods have been presented throughout the past two centuries. Cost benefit analysis and cost effectiveness analysis are two commonly used methods of evaluating economic/social viability of alternative actions. CBA or rather strictly, social CBA, therefore, extends this analysis to the area of government decision-making by replacing private benefits and costs with potential social benefits and costs derived from any social/public project.

Thus, though we may consider CBA in terms of public project(s), the scope of its analysis is very wide. It relates to any public decision that has an implication for the use of scarce resources. This is to say that, if the activity is worth subsidising, the net benefits must be positive. As defined by Prest and Turvey (1968), CBA is about “maximising the present value of all benefits less that of all costs, subject to specified constraints”. In so doing four inter-related questions arise: (i) which costs and benefits? (ii) how to evaluate them? (iii) what discount factor is to be used? and (iv) what relevant constraints to be considered?

Because cost-benefit analysis is a tool created to aid public policy making, its *raison d'être* derives from the legitimacy of public policy. Public policy has two major purposes which, by precedence and public acceptance, have come to be recognized by society as legitimate. These two purposes are to improve efficiency and to improve equity. A policy is said to be efficient if it maximizes the total net benefits (benefits

less costs) available to society, independent of who receives the net benefits. Equity, on the other hand, is not concerned with the "size of the pie", but on how the pie is distributed among the members of society. Cost-benefit analysis has traditionally been focused on efficiency on providing policy makers with an indication of the magnitude of net benefits associated with a particular project or policy. Although cost-benefit analysis is not specifically designed as a tool for evaluating equity, the cost-benefit analyst should also track the distribution of costs and benefits among the various segments of society. In an ideal world, the analyst would attempt to determine how benefits are distributed by age, sex, income, race, geographic location, and time. At a minimum, the analysis should attempt to ascertain, to the degree possible, if imbalances between benefits and costs are present for those segments of the population, who are most vulnerable.

4.3.1 Efficiency Aspects

Economic efficiency is a measure of the *net* contribution of an activity or project to overall social welfare. Thus, economic efficiency is designed to answer the question of whether the redistribution of resources implied by a project results in a betterment of society. For example, flood protection may be enhanced by inexpensive educational programmes that inform citizens as to their rights under federal programmes, such as flood insurance. Alternatively, communities can be moved to less flood prone areas. Another project may call for increasing taxes to build a levy that would protect property values and other aspects of quality of life by preventing flooding. However, levies also disrupt local ecosystems, increase downstream flooding and can damage or destroy other valuable resources, as well as costing significant amounts to construct. In the case of the educational programme social

betterment may be readily apparent, but for either the relocation or the levy programmes, more careful consideration of costs, benefits, and their distribution is necessary.

While there could be many definitions of what constitutes the best outcome, economists have focused on two particular criteria. The first of these criteria is called a Pareto improvement, while the second is called a potential Pareto improvement.

A project is said to constitute a Pareto improvement if it improves the quality of life for some people, but does not make anybody worse off. Clearly, society should pursue all attainable Pareto improvements, because they help some people, but do not hurt anybody. However, in a complex, modern society with countries having hundreds of millions of people, and cities having millions of people, every project or policy in all likelihood will disadvantage some segment of society. This is particularly true because the provision of public goods is generally financed by tax dollars, so there is some cost to everybody who pays taxes. If policy makers rigidly applied the concept of a Pareto improvement for screening potential projects or policies, it is unlikely that any policies or projects would meet these criteria and be implemented.

Consequently, economists have suggested a less stringent criterion for determining if a project or policy improves the welfare of society as a whole. This criterion is that of the potential Pareto improvement. A policy or project is said to constitute a potential Pareto improvement if those who benefit as a result of the project or policy gain by more than the losses of those who are made worse off as a result of the project or policy. This type of arrangement of costs and benefits is called a *potential* Pareto improvement, because those who gain could compensate the losers for their losses,

and still be better off. In fact, if the winners did compensate the losers, the *potential* Pareto improvement would become an *actual* Pareto improvement.

Most economists who examine public policy issues advocate the use of the potential Pareto improvement criterion as the determinant of whether a project or policy improves the welfare of society as a whole. They argue that because there is such a large portfolio of projects and policies, everybody benefits from some policies and incurs costs from other policies. Consequently, we should just search for the maximum difference between gains and losses, and use other mechanisms to address equity issues. Over a large number of decisions and a large number of citizens, it is argued, everybody benefits because resource allocation decisions systematically seek to obtain the greatest benefit at the least cost.

4.3.2 Equity Aspects

Unlike efficiency, which seeks aggregate gains, equity seeks to determine if costs and benefits are systematically reallocated in ways that discriminate against citizens least able to protect themselves, or in favour of citizens who already enjoy advantage. Thus, some potential Pareto improvements may be deemed undesirable no matter how large the difference between gains and losses. For example, many would argue that a policy that benefited Bill Gates by 10 billion dollars, but increased the taxes of middle class taxpayers by one billion dollars would be undesirable, even though it generated net benefits to society as a whole of nine billion dollars.

4.4 Examination of Key Technical Considerations

Once a decision to carry out a cost-benefit analysis is made, the conceptual concerns raised above are set aside and the pragmatic business of specifying the overall framework to be used, the input variables to be included, how to measure them, and many other decisions must be made. These decisions are not inconsequential, because seemingly innocuous choices, if arbitrarily made, can cause large swings in the outputs of the analysis. We provide an introduction to key technical choices.

4.4.1 Cost-Benefit Analysis and Time

In many applications of cost-benefit analysis, the analyst must measure the net benefits of projects or policies that generate costs and benefits over a period of time, with costs and benefits often occurring in different time periods. This increases the complexity of the analysis, because comparisons require a common metric. Cost-benefit analysis uses a process called discounting to express all future costs and benefits in their present value equivalent. This takes place by discounting costs and benefits in each future time period and summing them to arrive at a present value. This gives rise to one of CBA's weaknesses. This is because the discounting process calculates its results from the present generation's perspective, whereas one needs to be concerned about inter-temporal equity issues, that is, to the fairness of the decision to future generations. In fact, costs that occur far into the future may be given little weight in traditional cost-benefit analysis. Sustainability has developed as an additional consideration for public policy decision making precisely because of the concern that the process of discounting may steer us towards policies that overly emphasize short term gain. As with the consideration of efficiency, consideration of

sustainability provides the decision maker with additional information, but does not by itself make the decision.

4.4.2 Choice of Input Values

Carrying out the calculation of present value is mechanical, but the choices of values for input variables will ultimately determine the results of the analysis. Choices may be divided into parameter values and benefit and cost values. Parameter choices include:

- The discount rate
- Future rates of economic growth
- Future rates of population growth
- Future rates of inflation
- Future rates of technological change

Benefit and cost choices include:

- Benefits
 - Monetary values for marketed goods
 - Monetary values for non-marketed directly used goods
 - Monetary values for non-marketed passively used goods
 - Goods for which monetary values cannot be measured
- Costs
 - Monetary values for marketed input goods
 - Monetary values for non-marketed directly used goods that must be given up

- Monetary values for non-marketed passively used goods that must be given up
- Costs for which monetary values cannot be measured

Because the values chosen for these variables will significantly influence the final values calculated, the decision maker must satisfy herself that the values chosen are reasonable.

4.4.3 Dealing with Uncertainty

In addition, there is uncertainty in every variable estimated, including the most important categories of costs and benefits. For these reasons, it is important that a cost-benefit analysis does not present a single number as the sole estimate of net present values. Rather sensitivity and scenario analysis should be conducted to illustrate how the results change with different analytical choices and with variation in the uncertain levels of key costs and benefits. Finally, it should be noted that the cost-benefit approach, in itself, is a choice. In business decisions, other simpler models are commonly applied.

4.4.4 Choosing among Alternatives

Cost-benefit analysis is a tool for choosing among a discrete set of alternatives. For example, there may be several alternatives for dealing with a contaminated waste site. The site can be left the way it is, the waste can be contained, or the site can be completely re-mediated. Both the containment alternative and the remediation alternative may be further divided into alternatives based on options available in the technologies to accomplish each goal. Notice that by convention one of the alternatives to be examined is the option of doing nothing. Krutilla and Fisher (1985)

provide a thorough discussion of the comparison of alternatives in their analysis of several proposed hydroelectric dams in the Hell's Canyon area of the Snake River.

4.4.5 Choice of Discount Rate

The discount rate is the rate by which benefits that accrues in some future time period must be adjusted so that they can be compared with values in the present. In principle, this rate is the rate that equilibrates the demand for savings by investors and the supply of savings from savers who refrain from spending all of their income on current consumption. Savers compare the value of current consumption relative to future consumption and determine a rate of compensation needed to forgo current consumption. Choosing the correct rate for a cost-benefit analysis is important because society wishes, in principle, to undertake a mix of public and private investments that maximize social well-being. Whereas the marketplace drives private investments, activities by the public sector can displace private investment.

Consumers evaluate the decision to save or consume based on the opportunity costs of one choice versus the other, and other considerations about future needs. This process is called 'time preference' for evaluating present and future returns. Investors, on the other hand, consider the rate of return they expect from a given investment, using methods similar to those discussed in regard to calculating capitalized values. To undertake an investment, the expected return on investment must cover all costs, including the rate of interest. Under fairly restrictive assumptions, one can argue that investment will continue until returns across alternatives are the same and just balance the returns required by savers. Under these conditions, one can argue that a single interest rate and a single rate of return on capital will prevail throughout the economy.

In the real world, however, there are a number of reasons that multiple rates prevail. The choice facing the decision maker is which of these many rates to apply in cost-benefit analysis.

There are a number of reasons that multiple interest rates are observed in the real world economy. First, interest rates take into account average changes in the value of money. Most cost-benefit analysis is carried out under the assumption of constant dollars, that is, under the assumption that inflation is zero. Rates observed in the marketplace, in contrast, reflect borrowing over strictly specified time periods and hence incorporate expectations for inflation over those periods. For practical purposes, cost-benefit analysis can ignore inflation.

A second concern is that businesses pay taxes on their profits and that the rates of return they set as target must take the payment of taxes into account. Individuals, likewise pay taxes on interest they receive on savings. Hence, observed interest rates are distorted by the fact they reflect before tax rates of return. We will discuss this further below.

A third concern is that observed interest rates incorporate risk and uncertainty. For practical purposes, risk can be thought of as an adjustment that must be made to the interest rate to compensate lenders for the eventuality that borrowers will default. Although there are complicated analyses that help savers build portfolios that overcome uncertainties associated with specific borrowers, there remains a level of risk that cannot be overcome by portfolio building. In simple terms, if a lender believes that on average one half of the loans made will not be repaid, a risk-adjusted rate of interest equal to double the rate of the lender's time preference will be required. This problem can be typically overcome, because it can be argued that

society, in making public investment should use a riskless interest rate, reflecting the fact that the government will not default on its debts.

Although it is possible to enumerate the reasons that differentiate interest rates, it does not mean that choosing a rate for analysis is a simple task. On the contrary, in the final analysis the choice of a rate is fairly arbitrary. For this reason, it is typically the case that individuals who favour larger government investments to protect the environment can make arguments in favour of low rates whereas those who would like to see smaller government involvement in the economy can make equally plausible arguments for higher rates. It is unequivocally the case that higher interest rates will lead to fewer projects presenting positive net present values than lower ones. Unfortunately, the arguments used to support these positions are both complicated and fail to lead to a definitive position.

Most conflicts in choosing a rate arise over the role that taxes play in determining interest rates. Because of corporate income taxes and personal income taxes, the rate of return on a private investment is greater than the after tax return. It is also true that the consumer (lender's) after tax rate of return time preference is lower than the before tax rate of return. This means that consumers make the decision of how much to save based on the after tax rate of return, while business investors make the decision of how much to invest based on before tax rates of return.

The dilemma facing the choice of a discount rate is as follows. A decision to undertake an additional public project requiring investment can be viewed as displacing, either private consumption, private investment or some fraction of both. If one displaces consumption by undertaking the public investment, then the appropriate discount rate is the consumer's after tax time preference, a relatively low rate of

return. If one displaces private investment the investment displaced is at a higher, before tax rate of return. Because the purpose of cost-benefit analysis is to increase public well-being, it does not want to use parameter variables that lower the *effective* national rate of return on investment or that displace consumption by consumers inappropriately.

Several approaches have been suggested to cope with this problem. If one knew the proportion at which the public investment displaced private investment and private consumption the two could be weighted to form an average discount rate accordingly. Perhaps more appropriately one could apply a more complicated model to take into account the fact that the costs and benefits specifically related to displaced private consumption and displaced private investment occurring at different points in time. In practice, the information needed for either approach is generally unavailable. Thus, the debate appears to return to one's personal preference for public investment.

Whereas the choice of an interest rate is largely a quest to help the public sector choose investments that will improve the overall level of national economic well-being for a given set of consumers and investors, many investments take place over long time spans, some of which are long enough to be intergenerational. In particular, debates over long-term environmental issues such as global climate change tend to focus on inter-generational equity, rather than intra-generational efficiency. Simply put, an individual can decide whether they want to buy a new suit today and pay cash or to save that money and retire younger. But a decision to undertake carbon abatement to reduce the probability of global warming is a decision to forgo the increment of consumption or retirement forever. Moreover, because most benefits will occur long into the future, almost any reasonable discount rate, even one reflecting

consumption time preference, rather than private rate of return, will suggest that the project is inefficient. For these reasons, attention turns from efficiency concerns, getting the right rate of private and public rates of return, to equity concerns, taking into account the rights of future generations.

A complete discussion of inter-generational equity concerns is beyond the scope of this chapter. In general, economists argue that a social rate of time preference appropriate for intergeneration discounting would be composed of two components. The first is a "pure" time preference that is arguably zero, in the sense that a significant positive rate would preclude intergenerational investments. A zero rate means that well-being of future generations is given equal weight to the well-being of the current generation. However, due to a second component, that rate need not be negative. This second component reflects the fact that future generations will likely be much better off economically than the present generation, even at modest rates of economic growth. Hence, policies to sacrifice current consumption in favour of future consumption essentially transfer wealth from the poorer current generation to the wealthier future generation. Thus, a small, but positive social rate of time preference is justified. This rate combines the fact that economic growth will occur, adjusted for the fact that marginal increases in wealth will yield increasingly smaller increases in economic satisfaction.

When all is said and done, some rate must be chosen, and it is clear that no fully satisfactory rationale can be given for any specific choice. Persons favouring more government investment will argue for lower rates, and those favouring less will argue for higher rates. Some would argue in favour of the lower riskless rate of time preference by individuals. After taxes, a rate as low as three percent, based on long

term Treasury bonds may be chosen. Some would argue in favour of a higher rate to avoid displacing private capital. Others would argue for a middle ground.

For inter-generational deliberations a lower rate is argued. Assuming future growth rate of per capita income of 1 to 2 percent and an elasticity of utility for marginal income of 1.5, one would calculate a rate of 1.5 to 3 percent.

4.4.6 Allowing for Risk and Uncertainty

Risk and uncertainty are often used interchangeably in casual discussion, but they have very different technical meanings. Risk is defined as the variation in potential outcomes to which an associated probability can be assigned. In statistical terms, the distribution of the variable is known, but not the value from the distribution, which will be realized.

Uncertainty on the other hand, is the lack of knowledge concerning the probability distribution of future events. This implies that insurance is unavailable to protect against negative outcomes. Therefore, it is essential that the analyst must incorporate uncertainty into the cost-benefit analysis and that the decision-maker incorporates uncertainty into the decision process. A lack of knowledge does not preclude making assumptions concerning potential outcomes that should be taken into consideration. Imagine, for example, that a municipality is considering building a garbage incineration plant. An analyst examining the viability of the project could hypothesize that the future would look very similar to the present. That is, the population would remain stable, incomes in the municipality would remain constant relative to prices, the volume of garbage would remain relatively stable, the price of energy would not change, and the town's preferences for environmental quality would not change.

However, it should be expected that at least one, if not all, of these characteristics will change over the life of the incineration plant. Nevertheless, uncertainty is an attribute of virtually all decision processes.

How do we treat uncertainty as the key variables in cost benefit analysis? There are three major methods of analysing, estimating and allowing for uncertainty. First, the *expected value* analysis, which is designed to deal with risk and uncertainty by assigning probability estimates to alternative outcomes and then using these probability estimates to compute an expected outcome.

Of course, a key question here is how to formulate the probability estimates. For variables such as energy prices and population growth, one can look to well-developed forecasting models that predict these variables and have standard errors associated with the estimates. However, many times the analyst or decision maker will be confronted with variables for which there are no such forecasting models, such as the growth in the per capita volume of garbage. In this case, the analysts will need to make subjective probability estimates. The analyst or the expert would take into account various factors such as the changing age distribution of the population, predicted changes in income, and how they feel attitudes will change towards the environment and towards convenience products and make forecasts of future garbage streams and subjectively attach probability estimates to those forecasts.

Although expected value analysis incorporates aspects of the probabilistic nature of important variables, it does not usually incorporate all of the information that is known about the uncertainty of the variable. Thus, although the development of subjective probabilities is one way of treating uncertainty, it is not a complete

treatment. One reason for this is though probabilities being estimated, the method does not seek to evaluate the quality of the information underlying the probability estimates.

Second, the *sensitivity analysis*, which is a method for analysing uncertainty, by changing input variables and observing the sensitivity of the result. For example, if a positive present value is calculated for a range of discount rates, the analyst can conclude that uncertainty over which discount rate to use does not factor heavily in the analysis. The method can be employed either on a *variable-by-variable analysis* basis or by changing groups of variables at once using *scenario analysis*. These are closely related techniques that offer several advantages over other methods for examining the effects of uncertainty. Both sensitivity and scenario analysis can be employed in cost-benefit analysis to provide decision makers with improved information. The discussion below covers the methods of calculation, and advantages and disadvantages of each technique. Lastly, alternative methods for incorporating uncertainty are mentioned.

Sensitivity analysis is a simple and effective means for analysing uncertainty, which isolates the effect of a change in one variable on the cost-benefit ratio. This method is also referred to as the *variable-by-variable approach*. There are four steps to employing the *variable-by-variable approach*.

1. List all of the important factors that affect the cost-benefit flows.
2. For each factor define a range of possible values. The range usually consists of three to five values. These can be based on any relative measure. For example, estimates for each factor could be prepared under "optimistic", "most likely",

or "pessimistic" future states of the world. In practice, these values are usually based on past experience with similar projects or expert opinion. Occasionally, the range is even expressed as one or two standard deviations from a mean or expected value.

3. Calculate cost-benefit ratios or net present values for each value of each factor holding all other factors at their expected or most likely values. This means that if there are three factors and three estimates for each factor seven different benefit/cost ratios will be calculated.
4. The resulting cost-benefit ratios or NPV's should be examined to determine the degree of overall variation and which factor or factors is/are most responsible for variation in the estimates.

Scenario analysis, on the other hand, is based on the assumption that factors affecting cost-benefit flows do not operate independently of one another as is assumed in the *variable-by-variable* approach.

Sensitivity analysis has several advantages. First, it is relatively easy to compute the necessary information required for either approach. In fact, the researcher can simply assume a range of values around the most likely case, without undertaking a great deal of work. This is less true for scenario analysis than sensitivity analysis. Second, the process provides more information upon which to base a decision. In particular, it provides a notion of where the impacts of uncertainty are important for the analysis and where they are not. This could cause the analyst to gather additional information. Third, because the process requires a careful examination of the factors most likely to influence the cost-benefit flows, the analyst is better informed as to what the results of

the analysis truly represent. Finally, the potential interaction of factors is revealed when *scenario analysis* is employed.

Several disadvantages are also present. First, the determination of values that correspond to variations in key factors is based upon the best information at the disposal of the analyst. Inevitably, this implies the reliance on ad hoc methods for determining pessimistic, optimistic and most likely estimates. Also, the lack of a systematic method for determining the appropriate combination of factors used to define given scenarios limits the reliability of sensitivity analysis. Finally, while the *variable-by-variable* approach fails to account for factor interaction, the *scenario* approach usually only includes a small number of potential scenarios.

Finally, this type of analysis used commonly and is referred to *options analysis* where the analysts stepping back from the analysis and asking if the analysis is framed in the only way possible or if there are additional options that could better manage the uncertainty faced by the analysis. In general, two types of options analysis are available, one is sequential decision analysis and the other is the approach of irreversible investment theory.

Sometimes activities that appear to be all or none decisions can, in fact, be subdivided into stages, such that information gained during the early parts of the activity can be used to reduce the uncertainty in the later stages of the activity. Such divisions can sometimes be very trivial. For example, in years past, in the USA, no one financed a home other than by using a note with a fixed rate of interest over the life of the note. Whereas, this appeared to benefit the homeowner, because the same interest rate

would be used, what in fact occurred was that the lender was bearing the risk that other factors, like inflation, would remain constant over the life of the loan. The lender charged a risk premium for this service. When uncertainty over inflation increased, borrowers became aware that by using variable rate mortgages they could often decrease their costs of borrowing. In exchange for these lower costs, the borrowers engaged in risk sharing with the lenders. What in fact was done was the longer-term note was effectively broken into a set of shorter term notes with provision to adjust the interest rate as each note came due.

4.5 Jefara Plain Project: a CBA approach

In applying what we have already learnt, here we consider our case study. The Jefara Plain project should be regarded as a good example of social CBA, designed a ten-year project in the mid-1970s to settle a large nomadic population. As discussed earlier, and thoroughly examined in Appendix B, this project, amongst many, aimed to settle nomads into farming and agriculture related activities in a rather fertile north west of Libya. As most of these settlers had come from non-agricultural backgrounds, the project had envisaged to provide financial and training supports for these new farmers. Water, seeds, fertilisers, insecticides and machinery were given free of charge to these farmers in promoting modern modes of agriculture in the country. The project had also considered to provide continual technical and inspection supports for these new farmers. A typical farm allocated to settling farmers consisted of a three-bedroomed house, and around 25 hectares of land. The project offered farmers fixed salaries and a chance of boosting their incomes through sales of their agricultural products. The project was to cease by the end of 1985.

anticipating that farmers would be able to generate sufficient incomes independent of the state.

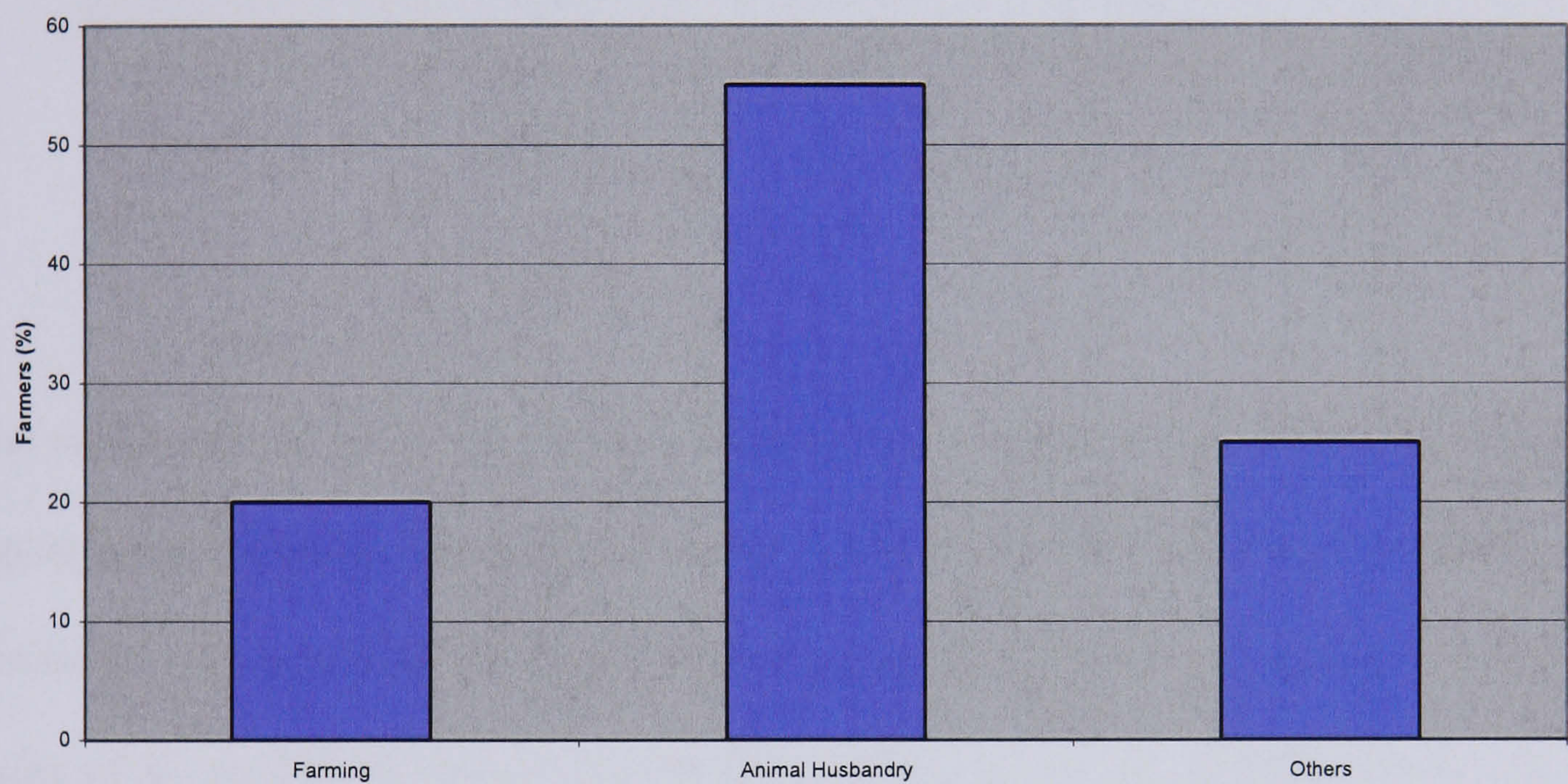
In evaluating the effective costs and benefits of the project, we resort to the method of willingness to pay, in identifying the farmers revealed preferences. In so doing, we developed a questionnaire followed by a series of field visits and interviews. The questionnaire was designed in satisfying two areas of these settlers: (i) the farm specific activity/production; and (ii) the farmers' specific characteristics. For the detailed analysis of the questions set out in the questionnaire, see Appendix C.

In the questionnaire, the aim has been to identify the areas where potential benefits have accrued, as claimed by the Government, and hence discover the possibility and the extent of such benefits. In this way we will be able to estimate the shadow prices derived from each item of benefit. This aspect will be examined in Chapter Five, using econometric modelling and estimation procedures. Here, we highlight some important issues and findings having arisen from the questionnaire and interviews.

An important part of the questionnaire and the follow-up interviews was designed to explore the settlers' backgrounds prior to becoming new farmers. The responses to such questions would clearly determine the extent of support, training and education that these new farming households would require in achieving efficiency in farming. As can be seen in Figure 4.1, only 20% of settlers declared that they had been involved with some form of farming prior to settlement, of whom one-half admitted that they had never worked with any agricultural machinery before settlement. A staggering 55% of these settlers had only been involved in animal husbandry and

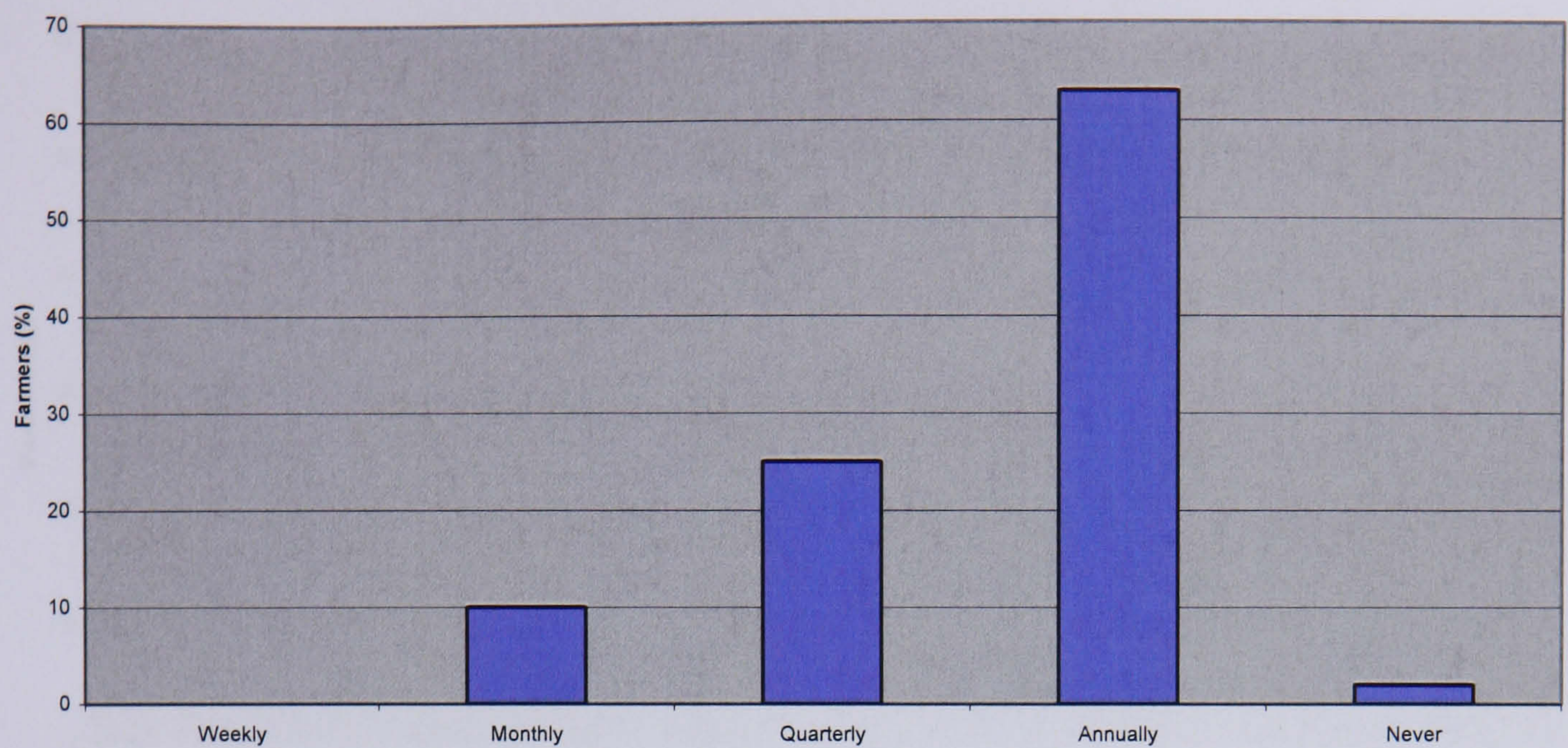
handcraft/cottage industry activities prior to settlement. Our follow-up interviews of this latter group showed that they had expected to have received significantly high levels of training and farming inspection at the early stages of their farming activities. As this figure suggests, a significantly large proportion of these households had very little idea about modern farming prior to settlement, and hence in desperate need of technical and training supports.

Figure 4.1: Farmers Activity Prior to Settlement



Against this background, most farmers whom we interviewed explained that some form of training and inspection were conducted on the monthly basis immediately after settlement. However, they admitted that after the second year of settlement, the frequency of such training and inspection fell drastically. Figure 4.2 shows the frequency of inspection over the entire life of the project (1975-85), indicating that only 10% of farmers received monthly inspection, with over 60% only had annual inspection. A small number of farmers declared that they had never seen any inspectors visiting their farms at all. Similar picture emerged from our interviews in relation to the Government’s claim on organising the evening classes on training and education support for the farmers’ wives and their dependents.

Figure 4.2: Inspector's Visits Frequency



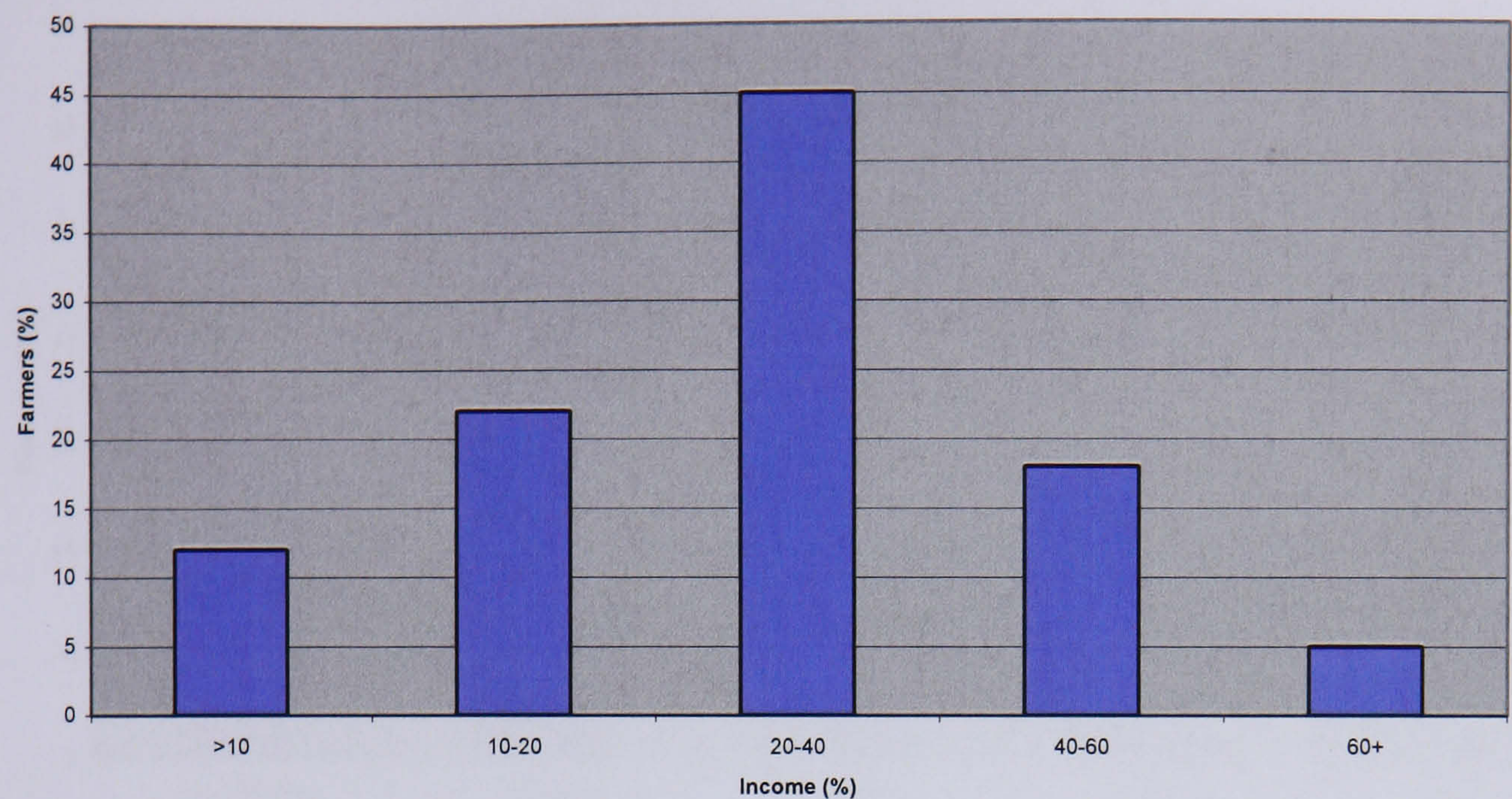
Our survey also included questions dealing with the availability of several agricultural inputs/facilities/tools. In particular, most farmers declared that lack of water and fertilisers were very evident in their poor farming performance. Figure 4.3 shows the index of all agricultural inputs availability over the entire life of the project. As can be seen, nearly 50% of all farmers believed that inputs have been poorly provided in their farming. Just over 20% of farmers responded that they were generally happy with inputs availability. Following our interviews, almost 60% of farmers showed their concern over equitability of sharing water with their neighbouring farms, as main source of animosity amongst farmers. They would have liked to have seen the agricultural authorities to have taken a more pro-active role in water distribution and other relevant farming inputs and tools.

Fig 4.3: Availability of All Agricultural Inputs



Primarily due to lack of inputs and appropriate agricultural training, most farmers appear to have failed to produce efficiently and hence lost interest in farming. According to our findings, nearly 30% of farmers only produced for their own consumption, and hence failed to meet the government’s objective. As shown in Figure 4.4, almost all farmers declared that they had to work outside of the farm in order to make ends meet. According to this figure, up to 65% of farmers declared that at least 20% of their incomes were maintained from outside work. For farmers living closer to major towns, it was easier to find non-farming jobs, as it represented nearly 80% of their family incomes. Against this background, some farmers expressed that lack of understanding of markets have been another important element in discouraging farmers to produce to markets.

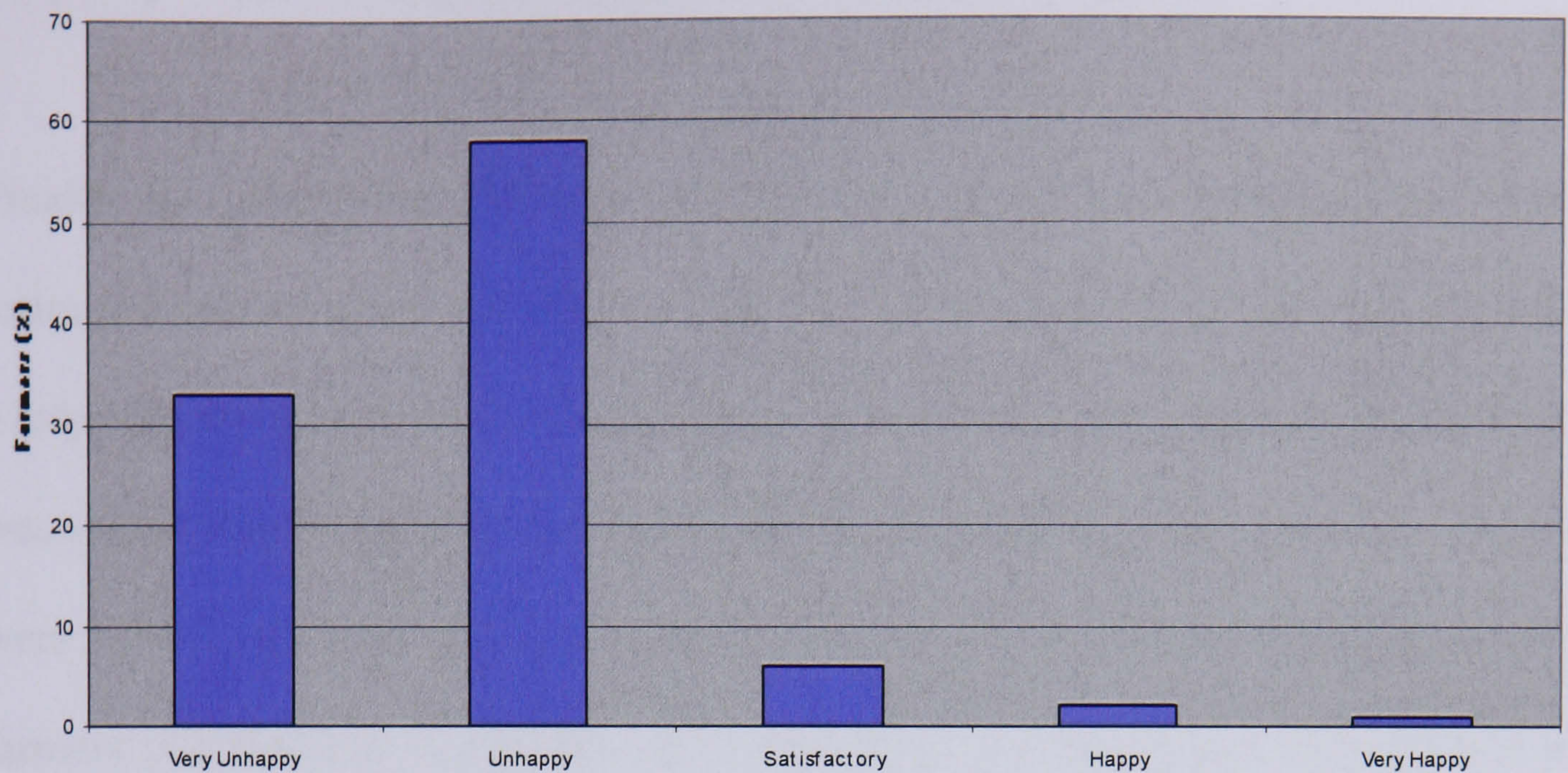
Figure 4.4: Share of non-farming income



The questionnaire offered a part where farmers had the chance to raise what they believed to have been the fundamental problems facing their farming activity. Nearly 80% of farmers were of the view that training and positive inspection were highly infrequent if not virtually absent. They thought that the cooperatives should have been more proactive and in charge of this activity rather than the government representatives, who had very little idea about the farmers’ needs. Lack of trust for government representatives (local and national) and other co-workers was raised as another important problem by nearly 30% of farmers.

Finally, to arrive at a conclusive verdict about the extent of potential benefits having arisen from this project, the farmers were asked to rank the extent of their overall satisfaction with their farming activity. As can be seen from Figure 4.5, nearly 90% of farmers declared that they were unhappy with the project. Only a small percentage of farmers (less than 10%) expressed as being generally happy with the project.

Figure 4.5: Index of Satisfaction with Project



4.6 Conclusions

This chapter has made an attempt at identifying and examining major areas of interests in cost-benefit analysis. In particular, the concepts of revealed preference and willingness to pay were identified to be the central and focal points in CBA. This is so, as in most cases one has to identify and measure the shadow prices leading to the estimate of total willingness to pay for a given service/good. Moreover, it can be argued that shadow pricing can be used to measure the unit costs associated to each factor responsible in provision of the new service. The examination of these shadow prices will enable the decision-maker to determine how costs and benefits should be calculated and allocated.

The chapter also identifies and examines the practical aspects of CBA by making references to the choice of discount rates, time preference, risk and uncertainty and means of estimating them through different methods. In particular, a main reference

was made to the sensitivity analysis, which appears to be a popular method amongst the policy-makers in their evaluation of relevant factors in CBA.

Finally, in identifying elements of costs and benefits in practice, this chapter examined data from the case study of the Jefara Plain land settlement project based on a large survey of over 500 farmers. Using a questionnaire and follow-up interviews, it was shown that the benefits that the government had initially estimated for this project were rather unrealistic and unattainable. In particular, a significant proportion of the farmers claimed that in majority of cases agricultural inputs and training had been poor if not non-existent. A detailed analysis of major determinants of land use in this project will be examined in the next chapter when we attempt to estimate the potential shadow prices accrued from the project.

CHAPTER FIVE

ANALYSIS OF DATA, MODEL SPECIFICATION AND ECONOMETRIC ESTIMATION

5.1. Introduction

This chapter primarily deals with statistical properties of the data gained from the questionnaire study and attempts to formulate a simple yet practical model for the purpose of econometric estimation. The model is deemed appropriate, as the estimated model will enable us to identify the extent of the contributions of the relevant explanatory variables. Moreover, the estimated parameters/elasticities can be used as good policy indicators in evaluating the real costs and benefits of the project. In effect, as mentioned in the previous chapter, some of the estimated parameters can be interpreted as shadow prices within the context of CBA to exhibit the extent of willingness of both the recipients and the providers of the service, hence being of significant use to policy-makers.

In part 5.2, some statistical properties of the data derived from the questionnaire will be offered. Part 5.3 examines a cross-section analysis of the proposed model, making references to the most typical potential problems of such analysis. Part 5.4 offers the estimated econometric findings, and associated issues vis-à-vis post estimation procedures. Finally, this chapter end with conclusions and summary of main points.

5.2. Statistical Properties of the Data

As a proper starting point, one needs to carefully examine the most relevant variables to be used in the study. As explained in the previous chapters, we conducted a questionnaire consisting of a large number of socio economic factors and applied to 546 farming households of the project. As our aim remains to be the evaluation of social and economic factors in exploitation of land in the project, here we select a limited number of explanatory factors, which are believed to give rise to determination of land use. In so doing, we will be able to examine the contribution made by each of these variables to the dependent variable.

For this purpose, four explanatory variables and one dependent variable were chosen. as follows:

Y: the size of exploited land (in hectares and percent)

X1: index of water access (between zero and 100)

X2: number of members of the family in farming

X3: index of all inputs (including fertilizers and seeds, but excluding water)

X4: index of training/education (between zero and 4)

Table 5.1 contains a summary of descriptive statistics of these variables, followed by Figures 5.1 to 5.5 presenting the distribution of these variables. As Table5.1 shows, in most cases mean and median values tended to coincide, with the exception of variable X4, where the difference between mean and median is significant. In all cases, normality is absent, and the distributions appear to bear to the left with long tails to the right indicating positive measures of skewness. This is also supported by the respective standard deviations and coefficients of variation (CV) estimates.

Table 5.1: Basic Statistical Characteristics of the Variables

Statistical Measures	Y	X1	X2	X3	X4
Mean	34	25.7	3.0	1.28	0.69
Median	31	23.1	3.0	1.00	0.00
Skewness (%)	1.2	1.32	0.5	1.58	0.84
Std. Dev.	13	10.8	0.7	0.51	0.86
CV (%)	39	40	24	39	124
Jarque-Bera*	217	327	34	333	72

* All statistically significant at the 1% level.

The test for stability of the central tendency is represented by the Jarque-Bera statistic, which are statistically significant at the 1% level in all cases.

Figure 5.1: Distribution of Exploited Area

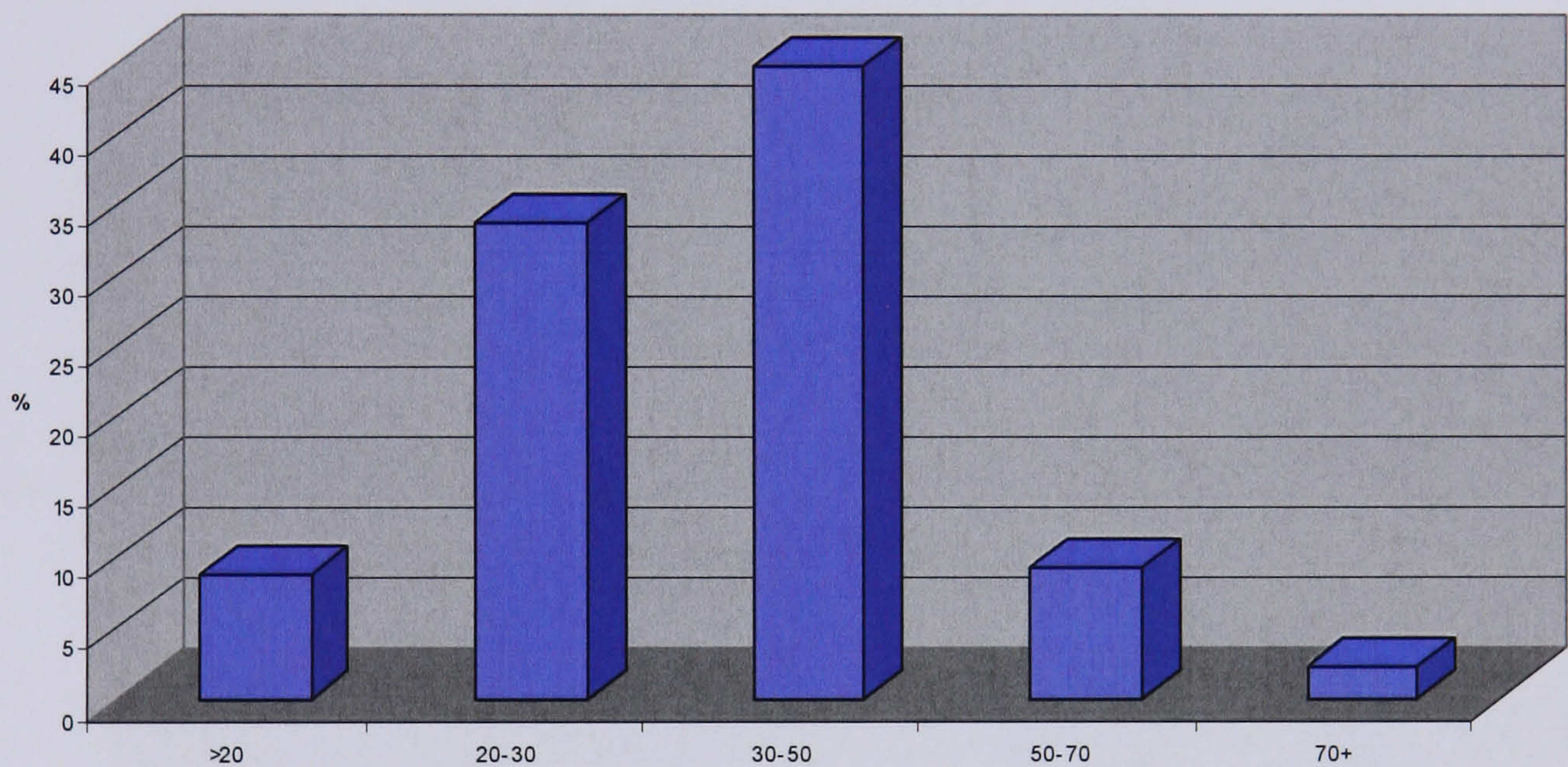


Figure 5.2: Distribution of Water Access

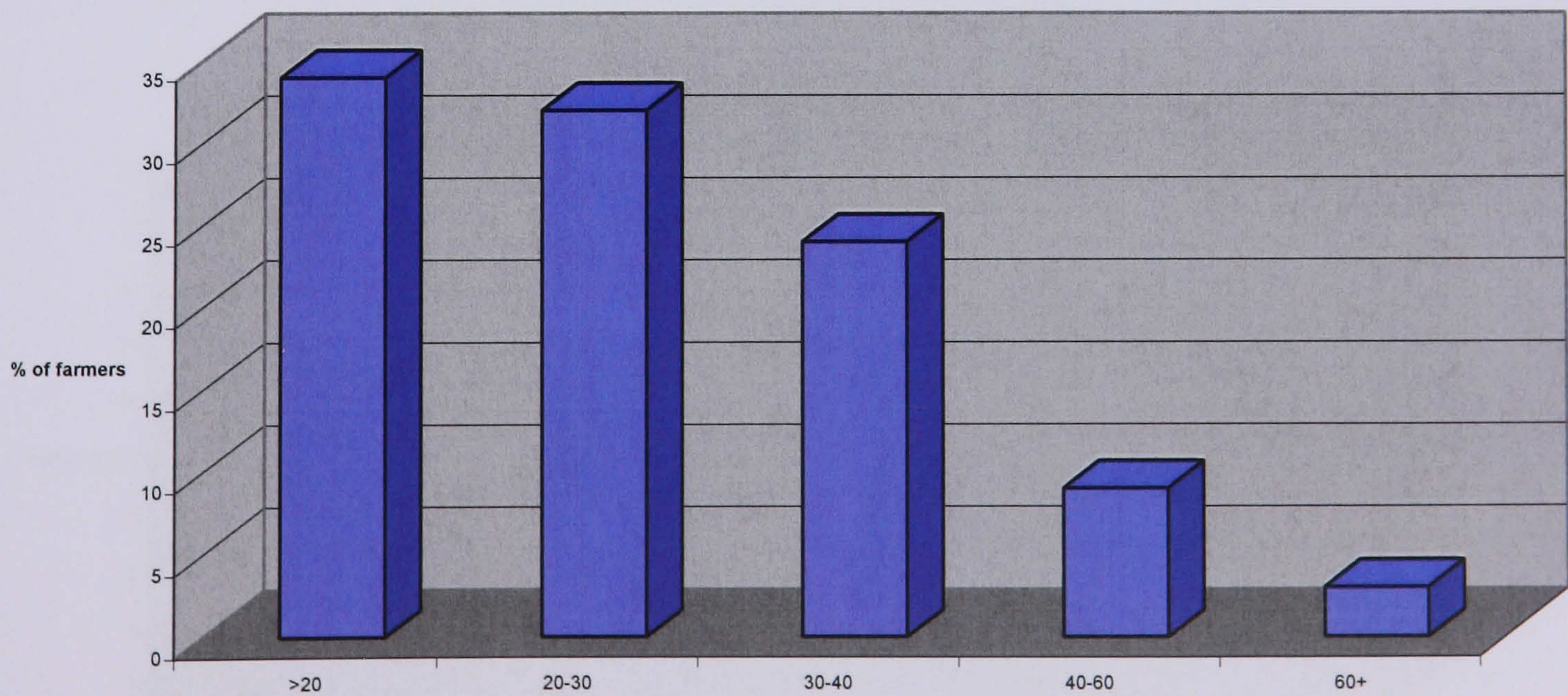


Figure 5.3: Distribution of Working Family Size

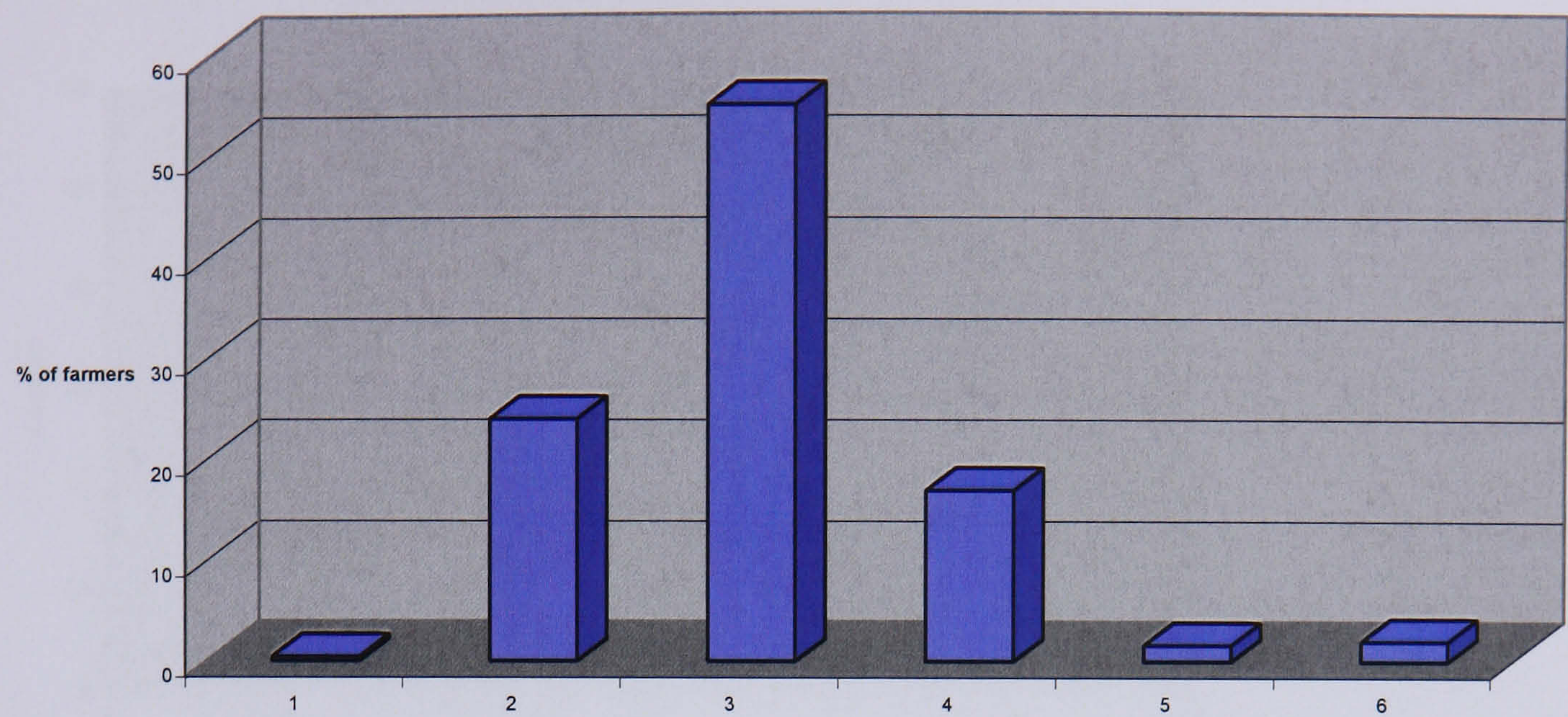


Figure 5.4: Distribution of Availability of Inputs

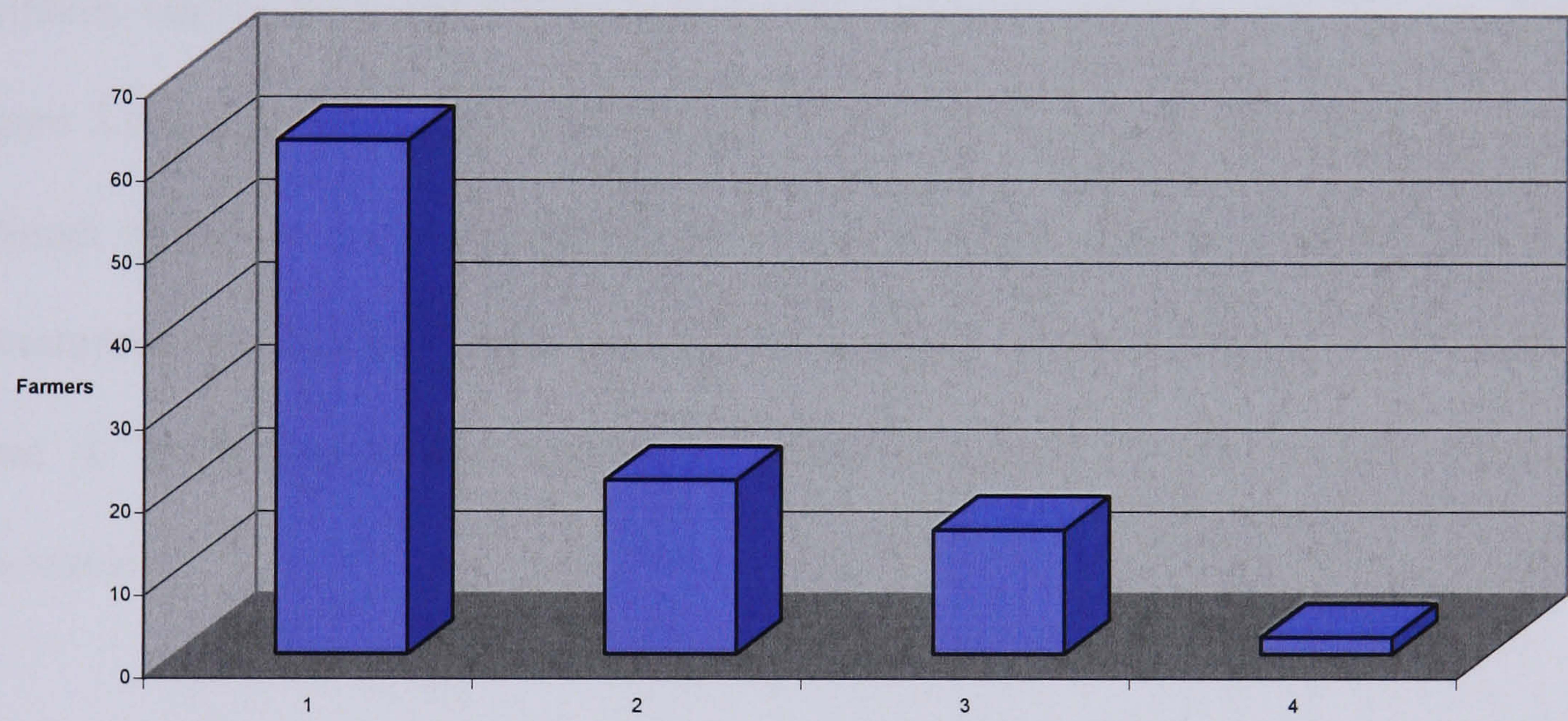


Figure 5.5: Distribution of Training & Education

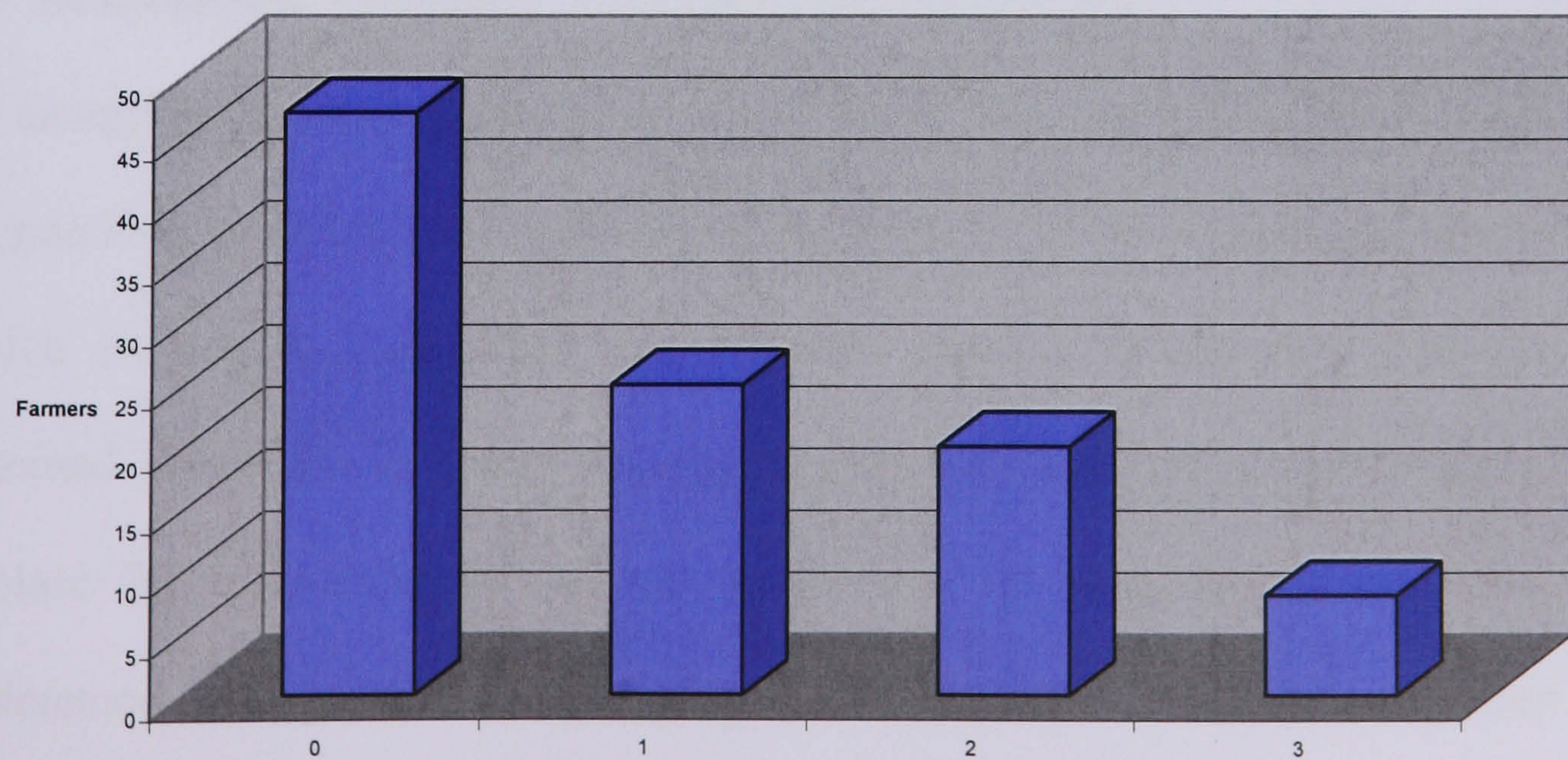
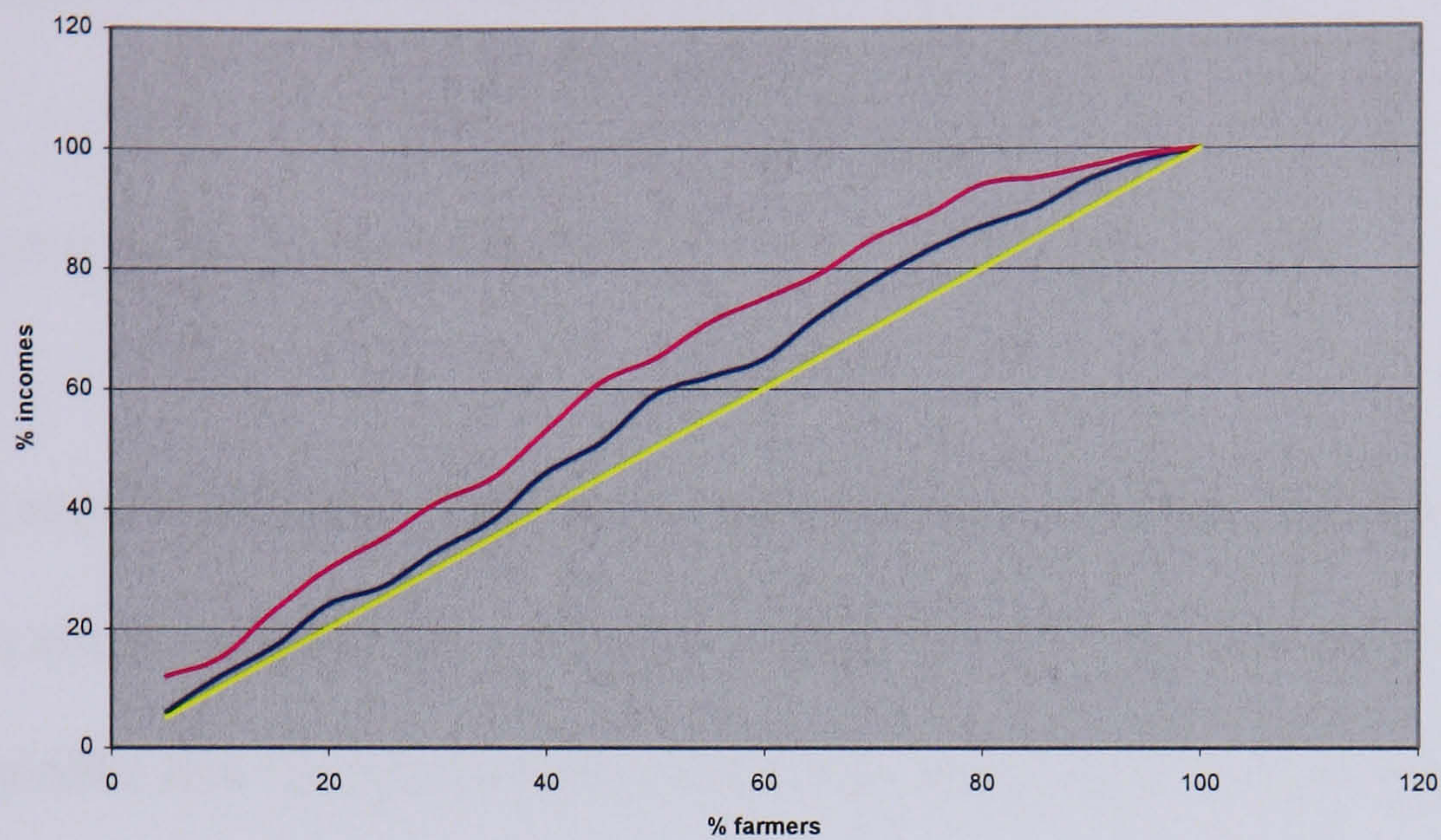


Figure 5.6: Income Distribution: Jefara v National



Figures 5.1 to 5.5, once again, support the non-normality distributions of all the variables which are more pronounced in the cases of variables X1, X3 and X4. Figure 5.6 shows the income distribution in the Jefara plain as compared with the national picture in 2002, published by the government. As it is claimed by the government that the land settlement project enabled farming families in the Jefara Plain to enjoy much less income disparity compared to the average Libyan household.

5.3. Econometric Modelling and Estimation Procedures

As an appropriate starting point, one needs to define and construct a mathematical or econometric model for the purpose of estimation. Here a simple model, is used which is easy to understand, communicate and test empirically with the data obtained. There are problems associated with oversimplified models, which fail to explain the complexity of the real world. In the model presented, below it is understood that political factors play important roles in determining land use. However, since most political/social indicators may not be easily quantified, we

attempt, therefore, to measure their contributions in terms of the intercept term or of the error of the model. Based on the variables introduced in part 5.2, our econometric model is based on a linear/log-linear form may be shown as:

$$Y_i = \alpha + \beta X_{1i} + \gamma X_{2i} + \delta X_{3i} + \theta X_{4i} + u_i \quad i = 1, 2, 3, \dots, 546 \quad (5.1)$$

In expression (5.1), Y , the land usage share, being the dependent variable; and the X s are the explanatory variables as defined earlier jointly determining the dependent variable and the coefficients/elasticities shown as $\beta, \gamma, \delta, \theta$ represent the respective size of contributions made by respective right-hand side variables. The intercept term is shown as α . Finally, the term u represents a classical white-noise disturbance term with zero mean and fixed variance; that is the error term satisfies the white-noise conditions, so that $u_i \sim \text{NID}(0, \sigma^2)$.

In building this classical model, special reference must be made to the underlying assumptions in relation to the X s and u . The X s are fully independent, so that the direction of causality is from X to Y and not the reverse. Moreover, these independent variables have no strong correlation with one another; nor do they have any association with the error term, u . Finally, in relation to u , there is no correlation between successive values of the error term, making it possible for the u term to enjoy zero mean and fixed variance. This assumption is referred to as *homoskedasticity*. Using the expected value, E , these assumptions can be shown in the following forms:

$$E(X_i X_j) = 0 \quad (5.2)$$

$$E(X_i u_i) = 0 \quad (5.3)$$

$$E(u_i u_j) = 0 \quad (5.4)$$

So, the above model will yield unbiased, efficient estimators, provided the above assumptions are to hold. The breakdown of any of these assumptions will render the property of unbiasedness of the estimated coefficients and hence reduce the degree of precision of these estimators in predicting the true contributions of X_s in determining Y . In short, the breakdown of assumption 5.2 will lead to the problem of *multicollinearity*, generally believed to be serious when the simple correlation coefficients amongst X_s exceed the multiple coefficient of determination. Moreover, the breakdown of assumption 5.3 and 5.4 will lead to the so-called *heteroskedasticity* problem, where the variance of the error term may vary significantly from observation to observation. Since in most cases such problems tend to occur in a multi-variate setting, we need to explore the underlying issues relating to the detection and elimination of these problems once they have occurred.

5.3.1. Multicollinearity: Detection and Elimination

The term *multicollinearity* was first introduced by Frisch (1934) referring to a situation where the variables dealt with were subject to two or more relations. In effect, he assumed all right-hand side variables be subject to error, and hence the problem was to estimate the different linear combinations amongst the true variables. As discussed by Maddala (2003), multicollinearity or high inter-correlations amongst explanatory variables need not necessarily be a problem. However, if it is proven that the extent of relationships amongst explanatory variables is acute, one needs to re-specify the model to increase the degree of precision of the estimated coefficients.

The degree of acuteness is normally measured by examining the estimated standard errors of the parameters. If they are exceptionally high, yielding statistically insignificant estimators, this may be regarded as a symptom of multicollinearity. However, high values of partial correlations need not necessarily imply high standard errors, and conversely, even low values of partial correlations can produce high standard errors. In short, detection of multicollinearity merely through partial correlations is not sufficient to lead us to any concrete verdict on the presence or absence of multicollinearity. In the case of models with more than two explanatory variables, what has to be considered are multiple correlations of each of the explanatory variables with the other explanatory variables.

There have been several rules of thumb suggested in the literature in detecting multicollinearity when it is proven to be a serious problem. Klein (1962), for instance, regards multicollinearity as a problem only if the coefficient of multiple correlation, R^2 , falls short of any partial correlation coefficients, r^2 . This method appears to be simple and applicable, but fails to be sufficient in the detection of multicollinearity, as it does not consider the estimated standard errors as the basis of detection. By the same token, the other two common techniques, namely the *variance inflation factor* (VIF) and the *condition number* (CN), though attempt to relate the estimated coefficients variances to explanatory variables multiple correlations, they fail to relate to other factors giving rise to high standard errors. Model misspecification, sampling inadequacy, and incorrect parameterisation are some other problems leading to potentially high standard errors, rather than a mere examination of multiple correlation coefficients. Grilliches et al. (1962), Smith (1980) and Maddala (2003), among others, have made attempts to detect multicollinearity in cases where Klein's rule has rejected serious multicollinearity. In

short, the mere examination of the partial/multiple correlations amongst explanatory variables does not mean that there are no problems with inference.

Once a case of serious multicollinearity has been detected, it must be eliminated, as multicollinearity leads to incorrect and imprecisely estimated coefficients. There is no single solution here. Model re-specification, including the dropping or reparameterisation of variables, is highly recommended as the first and most important solution to the problem. Improvements in the data and re-sampling may in most cases prove to be successful in the removal of multicollinearity. Finally, another solution that is often suggested for tackling multicollinearity problems is the application of *principal component* regression, which is practical and simple to use. Although being useful in the determination of final number of independent variables, this method lacks economic theory as it is assumed that all explanatory variables be treated the same, and can be given in a k set of linear functions.

5.3.2. Heteroskedasticity: Detection and Elimination

As mentioned earlier, one of the assumptions of the classical linear model is that the errors, u_i , in the regression equation have a common variance σ^2 . This phenomenon is referred to as *homoskedasticity*. After conducting any OLS estimation, one needs to test for the presence of homoskedasticity. How can we trace heteroskedasticity? What if the homoskedasticity fails to be present? Would this affect the degree of precision and unbiasedness property of our estimators? The answer to the latter question is that the estimators fail to be good predictors when homoskedasticity is absent. The answer to the former question is that heteroskedastic errors tend to exhibit explosive variances as the value of X increases. This is to say that

assumption 5.3 will be violated. The problem of heteroskedasticity is sometimes tackled by estimating the regression in a non-linear or a log-linear form. However, in most cases, different types of treatment are required to eliminate the problem.

Several tests have been recommended in detecting heteroskedasticity. Firstly, the RESET test, suggested by Anscombe (1961) and modified by Ramsey (1969), involves regressing the estimated errors on different powers of Y and testing whether or not the estimated coefficients are significant. Naturally, the null hypothesis is that the estimated coefficient not being significantly different from zero, hence rejecting heteroskedasticity. For example, in a simple model $y_i = a + bX_i + u_i$ whether using y or X would yield similar results. In this case, one needs to run the regression in the form,

$$e_i = k_0 + k_1 X_i + k_2 X_i^2 + k_3 X_i^3 \quad (5.5)$$

where e is the estimated errors, and k_i represent the coefficients of the explanatory variables; giving the null hypothesis as $k_i = 0$.

Secondly, the test suggested by White (1980), involving regressing the squared estimated errors on all the explanatory variables, as well as their squares and cross products. In this case, depending on the number of explanatory variables, there may be many different forms of the estimated regressions. However, given the above simple expression, one of the forms of such regressions may be shown as:

$$e_i = m_1 + m_1 X_i + m_2 X_i^2 \quad (5.6)$$

Again, the null hypothesis ($m_i = 0$) needs to be verified in order to assure that there is no heteroskedasticity.

Thirdly, the Glejser (1969) test is based on estimating regressions of the absolute values of the error on different forms of X variables. Based on the simple model shown above, one form of such approach may be shown as:

$$|e_i| = p_0 + p_1 X_i^{0.5} \quad (5.7)$$

Once again, the estimated coefficients of X must not be significantly different from zero to verify the absence of heteroskedasticity.

Fourthly, there is a rather simple but effective method of testing for heteroskedasticity when a structural break has been identified as a main source of the problem. In this case as suggested by Goldfeld-Qunadt (1972), the observations are split into two groups, corresponding to pre and post break, and fit separate regressions for each and then apply the F-test to test the equality of the error variances. The case for homoskedasticity will be rejected once it is shown that the calculated F ratio has exceeded the F-distribution at the 1% level.

Finally, when the number of observations is large, one can use the *likelihood ratio* test, by dividing the estimated residuals into k groups with n_i observations in the i th group. Then estimate the variance of each group, σ_i^2 , and the variance of the entire sample, σ^2 . If we estimate $\lambda = \prod (\sigma_i)^{n_i} / \sigma^n$, then the term $LR = -2\ln(\lambda)$ will possess a χ^2 distribution with $k-1$ degrees of freedom. If there is only one explanatory variable in the equation, the ordering of the residuals can be based on the absolute magnitude of this variable. However, if there are two or more explanatory variables, then the predicted value of Y can be used. For example, given the above simple model, on the basis of 100 observations, and two unequal groups of 30 and 70 observations, it can be assumed that the following variances are found: $\sigma_1 = 0.50$, $\sigma_2 = 0.25$, $\sigma = 0.4$. These estimated variances yield the value of -52 for the likelihood

ratio. The absolute value of our LR is, therefore, much larger than the value of χ^2 -distribution with 1 degree of freedom and at the 1% significance level (15.3), hence suggesting a significant difference between the two error variances. This finding suggests that there is heteroskedasticity in errors, which have to be corrected.

Once heteroskedasticity has been detected, the next question is how to remove this problem. In order to find an answer to this question, one must consider the potential consequences of heteroskedasticity for the OLS estimators. As discussed earlier, under heteroskedasticity the least squares estimators remain unbiased but inefficient, meaning that the estimated variances are biased thus invalidating the tests of significance. To demonstrate this, let us consider a simple model in the form:

$$y_i = \beta x_i + u_i \quad \text{where } E(u_i)^2 = \sigma_i^2$$

The least squares estimator of β , here shown as b is given:

$$b = (\Sigma xy / \Sigma x^2) = \beta + (\Sigma xu / \Sigma x^2)$$

Under homoskedasticity, as the expected values of u and Σxu are zero, then the expected value of b would equate β , and thus b is unbiased. However, given that the variance of the errors is non-constant, the variance of the estimator can be shown as $V(b) = (\Sigma x \sigma_i^2) / (\Sigma x^2)$ where $\sigma_i^2 = \sigma^2 z_i^2$, and z being known variances of x . In short, z is a ratio of the heteroskedastic error to homoskedastic error, σ_i / σ . Since z is known, it can be used as a deflator in correcting for heteroskedasticity.

Considering what said above, by dividing our observations by z , we will automatically correct our problem. Dividing our model by z we will get:

$$y_i^* = \beta x_i^* + u_i^*$$

where $y_i^* = y_i / z_i$, $x_i^* = x_i / z_i$, and $u_i^* = u_i / z_i$.

Note that u_i^* has a fixed variance. Since we are weighing or deflating the i th observation by z_i , the OLS estimation is referred to as the weighted least squares (WLS). The estimated coefficient β is now both unbiased and efficient. In short, the WLS estimators are derived under homoskedasticity.

The analysis above shows that no matter what technique is used in detecting heteroskedasticity, one needs to calculate a suitable deflator or weight such as z shown above. The weight will enable us to convert OLS into WLS, where the latter estimators are free from heteroskedasticity. One should note that in the case of the likelihood ratio test, one ends up with several weights depending on the number of sub-groups applied. Finally, sometimes it is possible to remove heteroskedastic errors without finding any weights/deflators, but merely through converting the simple linear model into a log-linear or a suitable non-linear form.

5.4. Econometric Application and Evaluation of Findings

Having constructed our linear model and identified the appropriate procedures regarding possible problems arising from the use of multi-variate models, we are now in a position to apply the data to the model, given as expression (5.1). As a first step, the OLS is applied to the data, and the estimated results are examined. Table 5.1 shows the estimated OLS findings. From this table it is clear that all the estimators have turned out to be statistically significant at the 1% level, and have all turned out positive, indicating that water access, family size, availability of inputs, and training/education all have direct positive impacts on land use. The value of R^2 is just over 0.50, indicating that up to 50% of the variation in the dependent variable is explained by the four independent variables. This also means that there is still

nearly 50% of the variation in Y which is not explained by these variables. Finally, the F-statistic, being 140.2, is highly significant, indicating the goodness of the fit of our estimated model.

TABLE 5.2: Estimated Expression (5.1) using OLS

<u>Variable</u>	<u>Coefficient</u>	<u>t-statistic</u>	<u>Prob.</u>
C	-0.2736	-0.1472	0.8830
X ₁	0.4758	11.8534	0.0000
X ₂	2.7541	4.8583	0.0000
X ₃	9.4664	10.7911	0.0000
X ₄	2.5167	4.9989	0.0000

R ² = 0.508 SER = 7.391 F-stat = 140.2 (0.0000)			

Despite these somewhat pleasing results, there may still exist multicollinearity and heteroskedasticity, which need to be detected and remedied. First, we consider a test for the presence of multicollinearity. As explained earlier in this chapter, in the case where the estimated standard errors of the estimators turned out to be low, one needs to examine the partial as well as the multiple correlation coefficients amongst the explanatory variables. If in any case these partial or multiple correlation coefficients turned out to be greater than the value of the R² shown in Table 5.1, then the explanatory variable(s) responsible for multicollinearity will be dropped out of our model. In so doing, we have estimated the partial correlation and multiple correlation matrices are shown in Table 5.2. As can be seen, in all cases, there appear to be very low correlations amongst the explanatory variables. The highest correlation is found in panel A, between X₂ and X₃, being 0.373; and between X₁ and X₄, being 0.352 – still much lower than the estimated R² shown in Table 5.1.

Therefore, the final verdict is that there is no serious multicollinearity amongst the explanatory variables.

TABLE 5.3:Detecting Multicollinearity–Partial and Multiple Correlations

A: Partial Correlation Coefficients

	X ₁	X ₂	X ₃	X ₄
X ₁	1.000			
X ₂	0.151	1.000		
X ₃	0.193	0.373	1.000	
X ₄	0.352	0.139	0.178	1.000

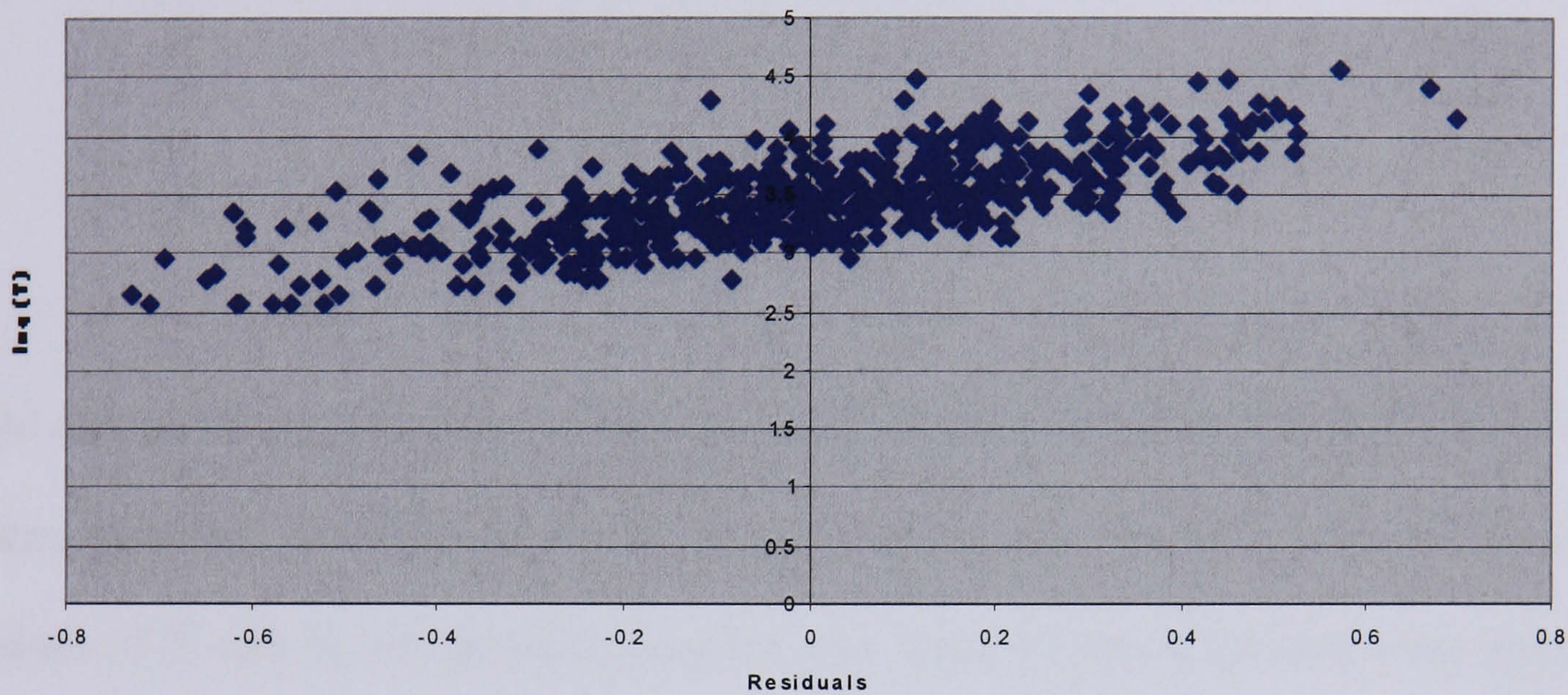
B: Multiple Correlation Coefficients

$R^2(X_1 \text{ on } X_2, X_3, X_4) = 0.145$
 $R^2(X_2 \text{ on } X_1, X_3, X_4) = 0.148$
 $R^2(X_3 \text{ on } X_1, X_2, X_4) = 0.166$
 $R^2(X_4 \text{ on } X_1, X_2, X_3) = 0.139$

Now we proceed with the test for heteroskedasticity, using the techniques discussed earlier. Here, we apply the tests that are relevant to our case: a large sample size with four explanatory variables. The Goldfeld-Quandt and likelihood ratio tests appear to be highly appropriate here. Moreover, we do apply the White’s test to check if any combinations of our explanatory variables may exhibit high correlation, with the estimated squared residuals. Prior to the application of these tests, it is advisable to a visually examinae the relationships between the estimated residuals and the independent variable.Because we have four independent variables,however it would be more appropriate to examine the relationship between the residuals and the

dependent variable. Figure 5.7 shows this relationship. A careful examination of this graph shows that a large number of observations are concentrated between 30-40 per cent with nearly zero margin of error. The overall picture of the residuals does not exhibit any eccentric explosive case, and hence on the basis of this visual examination, there seems no serious case for heteroskedasticity.

Figure 5.7: Residuals vs Dependent Variable



We begin our testing with the application of White’s test when attempting to identify any possible correlation between the squared errors and the explanatory variables. To conduct such a test, we should examine several combinations in which these explanatory variables can be associated with the squared residuals. These have been depicted in Table 5.3 with their respective estimated R^2 . As the values of R^2 in all cases are very small, we have therefore not shown the estimated standard errors of the respective coefficients. As can be seen from Table 5.3, no regression exhibits a large enough R^2 to indicate any serious correlation between the estimated residuals and the independent variables. So, according to White’s test, the estimated errors exhibit no heteroskedasticity. In other words, the results of White’s test detect no heteroskedastic errors.

TABLE 5.4: Findings From The White's Test (u^2 : dependent variable)

<u>MODEL</u>	<u>Variables Used</u>	<u>R²</u>
1	X_1, X_1^2, X_1^3	0.034
2	X_2, X_2^2, X_2^3	0.032
3	$X_1, X_1^2, X_1^3, X_2, X_2^2, X_2^3$	0.054
4	$X_1, X_1^2, X_1^3, X_2, X_2^2, X_2^3, X_1.X_2$	0.068
5	X_3, X_3^2, X_3^3	0.031
6	X_4, X_4^2, X_4^3	0.028
7	$X_3, X_3^2, X_3^3, X_4, X_4^2, X_4^3$	0.049
8	$X_3, X_3^2, X_3^3, X_4, X_4^2, X_4^3, X_3.X_4$	0.055
9	models 1, 2, 5, 6	0.103
10	models 4 and 8	0.142

The second test is based on the Goldfeld-Quandt test of heteroskedasticity. The data were examined carefully and it is noticed that for the first 300 observations the values of Y and X_1 are relatively smaller than those of the remaining observations. For this reason, our two sample sizes are identified as $n_1 = 300$, and $n_2 = 247$. We, therefore, ran two separate regressions on our linear model for these two samples, and the two estimated error variances, σ_1^2 and σ_2^2 , which turned out to be 24.23 and 66.62, respectively. The estimated F ratio, therefore, is given by dividing 66.62 by 24.23, which means that $F = 2.76$, which is smaller than the value of F-distribution at the 1% level of significance with $(n-k)$ and $(n-1)$ degrees of freedom. This suggests that we cannot reject the null hypothesis that the errors are homoskedastic. As the Goldfeld-Quandt test suggests, therefore, there appears to be no sign of heteroskedasticity.

For the final test for heteroskedasticity, the likelihood ratio test was used. Based on the same two samples as used for the Goldfeld-Quandt test, having got the two samples error variances (24.23 and 66.62), and the full sample error variance, as

83.38, calculated from Table 5.1, we are now able to calculate the likelihood ratio and hence the term $LR = -2\ln(\lambda)$. On the basis of this information, in consideration with what said in part 5.3, the absolute value of $LR = 86.76$, which is larger than the χ^2 distribution (at the 1% level) at 11.66, indicating that there appears to be some degree of heteroskedasticity. So, as other tests have failed to detect any sign of heteroskedasticity, here the likelihood ratio test indicates that the case of homoskedastic errors is refuted.

As mentioned earlier, the likelihood ratio test is the most appropriate test for our case study, as it is designed for multivariate models with large sample size. Here we need to correct our data in order to remove the heteroskedastic errors. Since we have divided the sample into two sub-groups, the estimated standard errors of each group will be used as weights in deflating the data. Once the data is deflated, the OLS is applied to the new data, and the new estimates are referred to as the weighted least squares (WLS) estimates, as explained earlier. So, the final, reliable estimates will be those based on WLS rather than OLS. Table 5.4 gives the estimated coefficients of WLS. For the means of comparison, we have also shown the OLS estimates (from Table 5.1) in this table. A careful examination of these results indicates that the WLS yields a much lower SER compared to that of the OLS. Likewise, all the estimates are statistically significant at the 1% level, as shown by their respective estimated standard errors (shown in brackets). Although there appear to be some similarities in the size of these estimated coefficients from the two methods, in all cases the OLS tends to over-estimate the true values of these coefficients. One must note that the estimates of R^2 have not been shown in this table, as the WLS is a non-linear approximated model of OLS, and hence R^2 does not represent a measure of goodness

of fit in this case. In this case, instead, an appropriate measure of fitness should be considered as the standard error of regression (SER), as shown in this table.

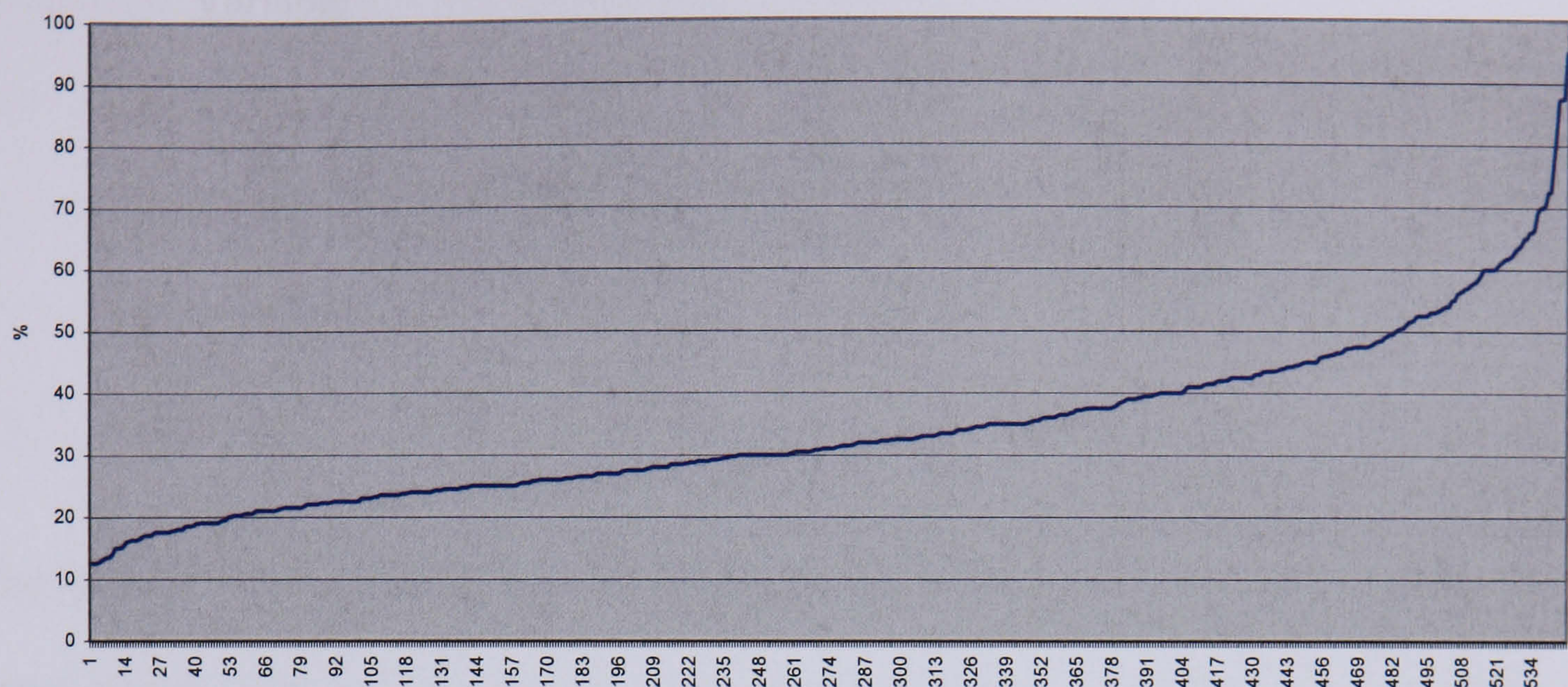
As a final note here, one must bear in mind that though there are differences in these two methods of estimation, in all cases, with the exception of the constant term, these differences are not statistically significant.

TABLE 5.5: Comparison of OLS and WLS Estimates

<u>Variable</u>	<u>OLS</u>	<u>WLS</u>	<u>Difference</u>
C	-0.274 (0.202)	0.934 (0.065)	1.208* (0.132)
X ₁	0.476 (0.037)	0.451 (0.041)	-0.025 (0.039)
X ₂	2.754 (0.429)	2.365 (0.367)	-0.389 (0.353)
X ₃	9.466 (0.858)	8.946 (0.803)	-0.520 (0.832)
X ₄	2.527 (0.501)	2.298 (0.453)	-0.229 (0.477)
SER	9.38	1.17	-8.190
* Statistically significant at the 1% level.			

A possible alternative, as argued elsewhere, may be to convert the linear model into non-linear from provided the dependent variable exhibits non-linear movements. An examination of our dependent variable shows that it grows exponentially after the 120th observation. This is depicted in figure 5.8.

Figure 5.8: Land Use



In effect, over a large part of the sample, as can be seen in the above graph, the dependent variable grows exponentially. This indicated that the use of a linear model can only be an approximation but not necessarily a perfect one. This is to say, that expression 5.1 should have been alternatively presented as:

$$Y_i = \exp (\alpha + \beta X_{1i} + \gamma X_{2i} + \delta X_{3i} + \theta X_{4i}) + u_i \tag{5.8}$$

By taking the natural logarithm from both sides of expression 5.8, we arrive at a simpler model of land use, as:

$$\ln(Y_i) = \alpha + \beta X_{1i} + \gamma X_{2i} + \delta X_{3i} + \theta X_{4i} + u_i \tag{5.9}$$

In order to estimate expression 5.9 all we need to do is to convert Y into log-natural and regress it on the right-hand side variables. It should, however, be noted that the estimated coefficients are no longer simple multipliers, but are referred to as the estimated elasticities relating respective Xs to Y. The estimated expression 5.9 is shown in Table 5.5. As can be seen, all the estimators have turned out to be highly statistically significant, and R^2 is estimated at 0.529, indicating that nearly 53% of variations in LY is determined by all the right-hand side variables.

TABLE 5.6: Estimated Expression (5.9) using OLS

<u>Variable</u>	<u>Coefficient</u>	<u>t-statistic</u>	<u>Prob.</u>
C	1.7612	17.644	0.0000
X ₁	0.4124	13.786	0.0000
X ₂	0.2717	5.843	0.0000
X ₃	0.3505	9.582	0.0000
X ₄	0.1566	4.084	0.0000

R² = 0.523 SER = 0.254 F-stat = 152.17 (0.0000)

The highest elasticity relates to X₁, water access, indicating that a 10% increase in water access leads to 4.1% increase in land use. Family size, variable X₂, and index of all other inputs, X₃, also exhibit relatively high elasticities. On the whole, the overall estimated elasticity, as shown in Table 5.5 turn out to be 1.20, indicating that in the long run, a 1% simultaneous increase in each and every explanatory variable will lead to a 1.2% increase in land use.

5.5. Conclusions

In this chapter we have made an attempt to develop and estimate an econometric model of land use on the basis of the data collected from the questionnaire. The aim here has been to estimate, using a simple linear/log-linear model, the marginal contributions made by each explanatory variable in the model. In so doing, a simple but practical linear model was first developed. The estimated model using OLS was offered and their predictability was investigated. At best, only up to 50% of variations in the dependent variable could be explained by the explanatory variables, meaning that there still remained a significant size of variations in dependent variable being unexplained. For this reason, the remainder of this section was dedicated to discovering the nature of the error generated by the OLS.

The model as it stood was subjected to tests for heteroskedasticity using different techniques. It was then discovered, using the log-likelihood ratio, that there may exist some degrees of non-homoskedastic error. Having treated for heteroskedasticity, the estimated results were then compared and contrasted. The overall picture showed that the estimated coefficients (elasticities and shadow prices) tend to be highly significant, but small in magnitude.

The estimated model was also subjected to a test for multicollinearity, going beyond the rule of thumb suggested by Klein. The examination of both the partial and multiple correlations showed that there was no sign of multicollinearity in the estimated model. Moreover, the examination of the standard errors of the estimated coefficients and the overall stability statistic (F-statistic) revealed that the estimated model was free from any serious multicollinearity.

On the whole, it should be noted that the estimated findings are indicative of a rather stable, robust log-linear model. As explained earlier, a significant proportion of the variations in the dependent variable still remains unexplained, indicating that some fundamental, yet non-quantified, political/social elements need to have been included into the model to improve the model.

CHAPTER SIX

SUMMARY, CONCLUSIONS, CONTRIBUTIONS AND LIMITATIONS

6.1 Summary and Conclusions

This research has been based on a critical examination and evaluation of the Jefara plain agricultural land settlement project in the north west of Libya. A total of 41 land settlement projects initiated in the mid-1970s were part and parcel of the so-called Integrated Agricultural Development Programme, which aimed to improve the general welfare of farmers and to enhance agricultural output.

Prior to Libyan independence in 1951 the agricultural sector absorbed about 80% of the labour force in the country and 95% of the domestic exports came from agricultural and animal products. Agriculture – and primarily pastoral activity – represented nearly one-quarter of GDP prior to the discovery of oil in Libya. After independence, the status of the agricultural situation remained almost unchanged; and as the terms of trade becoming unfavourable to agricultural products, the country became the recipient of massive international aid. However, the continuation of foreign aid was in consequence vital for the containment of further economic decline. According to these unhappy circumstances, in the early 1950s the United Nations accepted full responsibility for assisting Libya to achieve a higher standard of living through the design and implementation of an overall economic development plan.

Even after the discovery of oil in 1956, agriculture was still regarded as the cornerstone of the Libyan economy, but this changed in 1962 when crude oil was first exported. Despite offering generous budget allocations to agriculture primarily financed from oil revenues, the sector became stagnant. This appears to have taken

place in nearly all oil producing economies – cases of the so-called ‘Dutch Disease’. By the early 1970s, it had become clear that the agriculture sector was well and truly in decline as its contribution to GDP fell from its historic average of 25% to a mere 2%.

Following the Socialist Revolution in September 1969, Libya became an isolated and closed economy. The promotion of agriculture and industry became the main priority for self-sufficiency and survival strategy. In particular, the construction of agriculture had to be vigorously pushed through using subsidies to needy farmers, vast injections of social overhead capital, and, of course, land reclamation and agricultural settlements. In order to achieve these ambitious aims, a supposedly well designed, long-term plan for agricultural development was outlined for the period 1973-1980, and this was divided into two major plans: the three-year development plan 1973-1975, and the five-year transformation plan 1976-1980.

In short, agricultural policy in Libya, implemented in the 1970s and 1980s aimed at realizing the so-called ‘Green Revolution’ by transforming the traditional subsistence type of agriculture which had prevailed in the past into a mechanized, commercial and modern agriculture. To attain this objective, the revolution had exerted a great effort and allocated huge financial resources for the promotion of this supposedly vital and important sector of the national economy. The promotion of the productive sectors at any expense and without any regard to international terms of trade is a typical by-product of a closed economy. This is the development path that Libya chose over three decades.

The Integrated Development Plan 1976-80 must be regarded as the most important and prestigious development project, with the following aims:

1. The creation of new agricultural settlements in various parts of the country.
2. The revival and development of the abandoned and neglected former Italian settlements.
- 3 .The reclamation and development of new arable lands for the creation of public projects such as the cultivation of cereals (mainly wheat and barley), the cultivation of fodder crops for sheep and cattle raising, and the planting of tree crops for fruit production and the forestation of new lands.
- 4 .The resettling of the nomads, semi-nomads and farmers from remote poor oases in new agricultural settlements established in various parts of the country.

Nonetheless, the mainstay of the Integrated Agricultural Development was the creation of agricultural settlements in the following areas:

- i. Jefara Plain Region. This project comprised the Jefara Plain, the highlands and terraces of Jebal Tarabulus, and Khoms Misrata area.
- ii. Jabal El Akhdar Region. This area comprised Jabal Al Akhdar (Green Mountain) itself, Sahil Benghazi plain, the coastal strip of Marmarica (around Tubruk) and the Bulut area, south of the foothills of Jabal Al Akhdar.
- iii. Kufra and Es-Sarir Region. This area comprised the Kufra agricultural project area, 3 km south east of El Jowf, the central oasis, the Sarir agricultural project area, Jalo oasis and Marada Oasis.
- iv. Fazzan Region. This area comprised Sabha, Wadi Ash-Shati, Wadi El Amal (formerly Wadi El Ajal), El Aweinat-Ghat, Murzuk basin and Wadi El Ghatroon area.

v. Es-Sulul El Khudur Region. This area comprised several Wadi beds in the southern slopes of Jabal Tarabulus and south of Sirt.

The total area designated for the Integrated Agricultural Development Programme in the aforementioned regions during the period 1976-80 was estimated at just over one million hectares.

This study has adopted both theoretical and applied approaches in fulfilling its aim to assess the effectiveness of the Jefara land settlement project. On the theoretical side, on the basis of microeconomic analysis, the study lent itself to cost-benefit analysis aiming to examine the overall tangible and intangible costs and benefits of the project over the period of the study. The theoretical elements of CBA, as well as its practical aspects were fully considered in Chapter Four. In particular, the concepts of revealed preference and willingness to pay were identified to be the central and focal points of CBA, as in most cases one has to identify and measure shadow prices in order to estimate total willingness to pay for a given service/good. Moreover, it can be argued that shadow pricing can be used to measure the unit costs associated with each factor in provision of a new service. The examination of these shadow prices enables the decision-maker to determine how costs and benefits should be calculated and allocated. To observe these technical issues in action, the final part of this chapter has considered the case study of the Jefara Plain land settlement. Using data from the questionnaire and follow-up interviews, it was shown that the benefits that the government had initially estimated from this project were rather unrealistic and unattainable. In particular, a significant proportion of the farmers claimed that in the majority of cases agricultural inputs and training were poor or even not non-existent.

On the macroeconomic side of theory, as was argued, the research lends itself to the theory of growth and development. Chapter Three considered and examined different theoretical approaches to development with special reference to agricultural planning. As for the role of agriculture in economic development, a number of theories and strategies along with their respective strengths and limitations were examined. In so far as the developing nations are concerned, the major task in alleviating agricultural development is not necessarily related to capital accumulation, but rather is related to more fundamental issues arising from cultural/social phenomena. The new approaches to development offered by the so-called endogenous growth theorists point out more clearly the real potential contributions of external factors in assisting the development process, going beyond the provision of capital to modeling new ways of doing things. Social and political infrastructures have been identified as major sources of success or failure in any economic development.

On the methodological side of the analysis, the collection and examination of secondary data as well as the information obtained from the questionnaire completed by the farmers provided the appropriate tools of analysis, and a means to compare and contrast the farmers' view with the official statistics. The questionnaire distributed to well over 1000 farmers in the Jefara Plain produced 546 respondents. The questionnaire was designed and conducted in 2002 and aimed to capture information on socio-economic aspects of farmers settled in the Jefara Plain, investigating the likely determinants of land use by different farmers. The main characteristics of the questionnaire, the full data analysis, and relevant tables can be found in Appendix B. Moreover, the statistical properties of the data are presented in Chapter Five alongside the econometric applications. One interesting issue arising from the data analysis was

that the average farmer only used up to 35% of the land for cultivation. The main reason behind this under-capacity of operations was associated with lack of water and poor training.

The aim of the econometric application was to estimate, using a simple linear/log-linear model, the marginal contributions made by each explanatory variable in the model. In so doing, a simple but practical linear model was first developed. The estimated model using OLS was offered and its predictive power was investigated. At best, only up to 50% of variations in the dependent variable could be explained by the explanatory variables, meaning that there still remained a significant degree of variation in the dependent variable left unexplained. For this reason, the remainder of this section was dedicated to discovering the nature of the error generated by the OLS.

The model as it stood was subjected to testing for heteroskedasticity using different techniques. It was then discovered using the log-likelihood ratio that there may exist some degree of non-homoskedastic error. Having treated for heteroskedasticity, the estimated results were then compared and contrasted. The overall picture showed that the estimated coefficients (elasticities and shadow prices) tended to be highly significant but small in magnitude.

The estimated model was also subjected to testing for multicollinearity, going beyond the rule of thumb suggested by Klein. The examination of both the partial and multiple correlations showed that there was no sign of multicollinearity present in the estimated model. Moreover, the examination of the standard errors of the estimated coefficients and the overall stability statistic (F-statistic) revealed that the estimated model was free from any serious multicollinearity. On the whole, the estimated

findings were indicative of a rather stable, robust log-linear model. As explained earlier, a significant proportion of the variations in the dependent variable remained unexplained, indicating that some fundamental, yet non-quantified, political/social elements would need to be included into the model to improve its performance.

In conclusion, it should be said that the land settlement project, investigated appeared on the whole to have been an unsuccessful economic activity. Several factors have been identified which have given rise to these disappointing findings. First and foremost, land settlement in the short/medium run should be considered as a social-political strategy in settling the nomadic population. In the longer run, however, the economic gains of such settlement may be attained as these new households become engaged in production, consumption and saving activities, hence enhancing the overall performance of the economy. However, if land settlement is assumed as an immediately viable strategy in enhancing the economy – for self-sufficiency in food, and general improvement in output – the policy-makers can be said to have been short-sighted and in fact totally mistaken.

Secondly, if land settlement is only considered as a strategy in alleviating the welfare of a defined segment of the population, then the opportunity costs (economic and others) of the project in association with eventual benefits must be fully considered. If the benefits are expected to exceed costs (tangibles and intangibles), then such a project may become viable. In the case of Libya, the opportunity costs elements of such a strategy appear not to have been fully examined. For example, the allocation of 25 hectares of land per household in the settlement projects led to the generation of a large number of inefficient units of production. Moreover, lack of training for these

new farmers meant that an even smaller part of the land was actually used for cultivation, as these settlers had been traditionally involved in pastoral rather than cultivation activities.

Thirdly, under the land settlement project these farmers received annual salaries from the government, in addition to some income from farming. Due to the lack of markets for their products, these farmers gradually moved away from cultivation and many found ways of increasing their earnings by moving to cities and being involved in other activities. In short, a majority of these settlers became part-time farmers, as other activities became more attractive to them. Moreover, due to lack of government inspection and supervision, more and more farmers found it easier to partially migrate to cities in search of more attractive and rewarding activities.

Finally, the planning of the land settlement underestimated the seriousness of the ever-depleting water resources in the country. Although several ambitious projects for improving water quantity and quality were made, water still remains a scarce commodity and hence is an expensive raw material for agriculture. As basic economics suggests, in the case of scarce factor endowment, a country is always better off importing commodities which require such scarce factors in their production. In effect, in such circumstances, Libya would be expected to import general agricultural products from the rest of the world, whilst having specialised in other activities.

In short, land settlement could have been considered favourably if it had been intended to generate a new labour force in the overall economy, rather than forcing settlers into activities which may not have been economically viable. Therefore, it is

not surprising that a significant number of these settlers over the years fully migrated and settled in cities where more attractive jobs were available to them.

6.2 Contributions of the Study

This study is a detailed analysis of a land settlement project in Libya, which goes beyond the secondary information/data offered by the Government or its agencies. In an attempt to investigate the real effectiveness of the project, the research has designed and applied a questionnaire in the Jefara Plain settlement, in the North West of Libya. The questionnaire was distributed to all of the households in this settlement, and a respectable sample size of households responded fully – just over 50% of the total. The questionnaire aimed to address questions not only on output and productivity, but also on several socio-economic aspects of the households, such as family size, experience, training/education, etc.

Another contribution of the study comes from the application of CBA to the case study. To date, no comprehensive research on Libyan land settlement has considered the application and the findings of CBA. This research has not only considered the theoretical framework of CBA as applicable to agricultural development planning, but has also developed and applied a simple linear regression model of land use. The estimated parameters of this model are to be considered as shadow prices relevant to different variables: the marginal contributions made by each factor in the overall success/failure of the project.

The economic approach and the findings derived from this study should be of great interest to researchers and policy-makers in Libya. The findings, in particular, give

rise to the framework and the working of the concurrent issues on openness and free trade as means of specialisation and potential success, rather than the closed economy approach to self-sufficiency at any expense. Although the research is based on only one of the five Libyan settlement projects, one can however draw general conclusions relevant to the overall performance of such the projects.

6.3 Limitations of the Study

The research is primarily based on a case study – one of the five land settlement projects - and hence generalisation based on such findings may prove to be rather weak and inappropriate. Moreover, only 50% of the households in Jefara settlement project responded to the questionnaire, leaving the remaining 50% unrepresented.

Although the questionnaire addresses some aspects of farmers' conditions which change over time, the research was primarily based on a cross-section analysis of data for households at a given time. Moreover, due to the cumbersome nature of some fundamental yet highly qualitative factors, the research has not been able to explore these quantitatively. This has meant that a significant number of cultural/social/political factors have been excluded from the econometric model, hence giving rise to doubts concerning the validity of the findings.

6.4 Directions for Future Research

Future research in this area may be encouraged to concentrate on the following issues:

- 1) a comparative-static or a dynamic model of land use to overcome some of the problems encountered in this research. Such models would allow household characteristics to change over time;
- 2) compilation of data on prices or notional prices would be beneficial as these could replace the shadow prices estimated residually;
- 3) an input-output analysis could be beneficial here, allowing sectoral transactions between agriculture and other sectors of the economy, and factor movements amongst sectors.

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APPENDIX A: Integrated Agricultural Programme

1. The Programmes of Land Reform and Grain Dissemination.

The main purpose of this programme was to complete the previously committed projects and reform new areas and existing agricultural arable land for the purpose of agricultural production in various parts of the country.

The planned programme of new areas for the reform comprised more than 40,000 hectares (ha). This programme embraced the completion of the Taworgha project, with 3,000 ha situated south of Misrata, the El Gawarsha project, with 1,025 ha south of Benghazi, Wadi Tlal, with 2,700 ha, south of Sirt, and the development programme for the former Italian agricultural settlements in Dafniyah, Karareem and Tumminah west and south of Misrata respectively.

This programme comprised of 1,111 farms, with a total area of 22,220 ha and irrigated by waters from artesian wells and natural springs.

The Agrarian Reform programme included also the execution of 16 new projects:

- i. El Hadhba El Khadra (phase two) south of Tripoli city, with an area of 200 ha. this was designed for the production of fodder crops.
- ii. The 150 ha near Ez-Zawiya which was planned to be irrigated with water from the sewage-purification plant of Ez-Zawiya town. This project was created mainly for the production of forage crops.
- iii In addition to these two main projects, there were several minor projects, such as the projects of Karsa, west of Darna; Shat El Badin, about 100 km south of Benghazi; and the Ghadames-Darg area, situated 535 km southwest of Tripoli as well as the construction of dikes and terraces on the highlands of Gharian and Misallata.

2. Pasture Lands.

Most of the rural population in the past have traditionally been pastoralists. The nomadic and semi-nomadic way of life has prevailed over most of the country (outside of the urban centres). Therefore, one of the main goals of this plan was to improve the ranch land for better production of animal feed, particularly in palatable grasses on the one hand, and to increase the period of the grazing season from 4 months (present status) to 6 months by the end of the plan in 1980. The immediate result of this project was the fencing in of many areas in various parts of the country. Most of these areas were developed and mostly reserved for better animal breeding.

The target of this project was to reclaim and develop an area of about 800,000 ha in various locales in the maritime coastal land and the semi-desert (steppe) areas. The area planned for grass-seed dissemination was 31,900 ha. Scrub plants which can tolerate dry spells were also to be planted for animal grazing. This area comprises 17,175 ha. In addition to the improvement of the animal feed conditions, the plan included the creation of 242 water centres for animal drinking.

3. Animal Breeding Programme.

Since the rapid rise in the standard of living after the discovery oil in Libya, the demand for meat has increased considerably. Thus, the price of meat has subsequently increased year after year, For example, the cost of one kg of local meat in 1955, just before the oil discovery, was between LD 0.40 to 0.50 (\$1.43 to 1.78). by 2004 the price had gone up about twenty - fold (LD 10.000 per kg). As a consequence, annual production of animals failed to meet the increased demand.

Therefore, the country inevitably had to import from foreign countries, mainly Australia, Argentina and Brazil.

For example in 1975 Libya imported 29,000 tons of meat; however, this quantity covered only 38% of local consumption (See Table 2.14).

The main object of the plan was to increase animal production to attain at least 77% of local need by the end of the plan in 1980. This goal was however, to be achieved from the present animal population through the improvement of animal indemnity, providing better animal feed and introducing better breeds, as well as to create incentives among farmers by increasing government assistance and credit on the one hand, and securing prices for animal products on the other. This goal was achieved in 1980 by importing only 30,000 tons, which covered 23.4% of local need. In general, the animal-breeding programme comprised of five projects:

i. Cattle Breeding Project (Dairy-Farm Project).

At the initiation of the transformation plan, 1976-1980, cattle numbers in the public sector were 7,000 head distributed between seven dairy farms. In 1980, there were 6 more dairy farms were under construction. The target was to import 2,000 cows per year (See Table 2.15). At the end of the plan in 1980 the total number of cows was to reach 41,000 head. Consequently, 20 more dairy farms had to be constructed by 1980 in various parts of the country, such as Darna, Benghazi, Ez-Zawiya, Misrata, etc. This increase of cattle population would require the creation of 26 new farms for the production of fodder crops, comprising an area of 260 ha. Therefore, annual milk

production was expected to increase from 56.600 tons in 1975 to 357.600 tons in 1980 (See Table 2.16).

The Agricultural Bank was also to participate in this programme by encouraging the private sector to obtain credit with no interest to buy and raise milking cows, which usually were sold by the government at subsidized prices.

ii. Sheep Raising Project.

The available number of sheep herds in the public sector was 2, 700, 00 head in 1975. They were housed in the Garabulli, Bier El Ghanam, Misrata, Sabha and Brak ranches.

In order to produce enough feed for these flocks, the project dissiminated an area of 5,000 ha in Bier El Ghanam with selected grass seed in addition to an irrigated area of 35 ha cultivated with forage crops in Garabulli ranch.

However, the target was to promote the number of local sheep from 2,885,000 heads in 1975 to 4,420,000 heads in 1980, as a fixed total; and 600,000 head as a fluctuating number of sheep. The anticipated increase in sheep population would, of course, need more shelter for the sheep holders. Thus, the plan was designed to create more sheep farms and consequently more land needed to be cultivated for fodder crops.

The plan was also designed to produce 9,100 tons of wool by the end of the plan (See Table 2.16).

iii. Poultry Project.

The poultry project consisted of the following sections:

- a. Broilers.** This project was designed for the production of chicken for meat consumption. It comprised 32 chicken barns, divided between four main stations. These were the Jowdiddaim chicken-pollarding centre, with a capacity of 350,000 birds; Benghazi chicken-pollarding centre, with a capacity of 280,000 birds; and two more minor centres for chicken-pollarding, one in Gurgi near Tripoli and the other in Sabha in Fezzan.
- b. Incubator station.** This project was established for the production of chicks by mechanical devices. It consisted of two stations: for hens and meat chickens one was located in Tajura 16 km east of Tripoli, and the other was in El Fweihat near Benghazi.
- c.** Two small incubators for the production of chicks, meat and eggs were established; one located in Tripoli and the other in Benghazi.

The plan target was first to complete and develop the planned chicken barns by the end of the plan in 1980, to eventually produce about 26,000,000 birds per annum (See Table 2.17). This number is equivalent to about 26,000 tons of meat (See Table 2.16). This amount of meat would provide each inhabitant with about 8.6 kg of meat per year. The estimated annual meat consumption per capita in Libya in 1971 was 10.0 kilograms. Thus, Libya would reach self-sufficiency in meat produced from sheep, cattle, goats and camels if the level of consumption remained the same. However the target of the five-year transformation plan was designed to raise annual meat consumption per capita after 1980.

d. Egg Production Project.

Due to the rising standard of living in Libya, particularly in urban areas, eggs became a very important ingredient of the daily diet. Prior to the establishment of the egg production projects in 1975, the local production of eggs did not suffice for domestic consumption, nor did chicken meat. Thus, the country had to import more than 60% of its needs from foreign countries.

Since 1977, however, Libya reached self-sufficiency in egg production. This situation could not be guaranteed as long as the country had to depend on the importation of chicken feed from abroad, as well as of most of the chicks.

The egg production project consisted of four chicken barns (chicken farms) for raising hens and six chicken barns for egg production. However, some of these projects essentially are still in various stages of construction and by 1980 all these projects would be under production. It was estimated that this project would produce about 450,000,000 eggs (28,000 tons).giving each inhabitant 150 eggs per year. The annual consumption of eggs per inhabitant in 1974 was 24 eggs (See Table 2.16)

iv. Animal Health Care.

In addition to the animal breeding projects and the poultry project, this plan was designed to create service projects associated with animal breeding such as the establishment of milk collecting centres, scientific animal breeding stations, and poultry indemnity centres spread all over the country. In addition to this the plan was designed to establish 80 new veterinary clinics, mainly in the remote areas and particularly in the sheep grazing grounds.

V. Crop Production Programme.

The crop production programme consisted of several important projects. The main target of this programme was to increase production and improve the productivity of agricultural foodstuff commodities such as grain crops, fruit and vegetables, and to make them easily obtainable by the majority of nationals at a reasonable cost. But because of the erratic nature of rainfall, the scarcity of underground water for irrigation and the poor sandy soils in most parts of the country, the agricultural yield per hectare remained in most cases low compared to other countries with similar geographical conditions. For example, the yield of wheat and barley in Libya in 1971 was 280 and 290 kg per hectare, whereas in Jordan they were 800 and 900 kg respectively in Syria 360 and 700 kilograms respectively, and in the Yemen Arab Republic 725 and 1,070 kg respectively. The world average yield in the same year was 1,580 kg for wheat and 1,850 kg for barley. Similar situations also applied in most other agricultural products.

Nonetheless, the main object of crop production was to improve the quality of agricultural production and to increase the yield per hectare. This, of course, was to be achieved by the improvement of agricultural practices, good treatment of the soils and the implementation of modern machinery and equipment under the proper guidance of agricultural experts and well-trained personnel. The target was to increase the production of wheat and barley from 107,000 and 216,000 tons in 1975 to 336,000 and 245,000 tons respectively. The wheat increase over the plan period would be about 314% for wheat and about 113% for barley (See Table 2.18).

The crop production programme comprises several projects designed mainly to improve and increase the production these were:

a. Seed Project.

This project was designed to increase the production of good quality seeds to supply the demanding farmers for seeds for cultivation. The seed project was designed also to cultivate an area of 230,000 hectares, with well-selected seeds during the first year of the five-year plan, and subsequently this area would be increased by 30,000 hectares per year, till it reached 350,000 hectares at the end of the plan in 1980. This area would produce 155,350 tons per year starting from 1980.

The crop production project also included the construction of eleven-grain storage, silos with a total capacity of 250,000 tons.

b. Fruit Project.

The main target of this project was to improve the quality and increase the production of fruits. This was to be achieved by importing the best fruit seedlings from abroad and planting them in the country. It is worth mentioning, however, that the number of fruit seedlings planted in Libya in 1974 was 1,682,495 seedlings, of which 186,980 seedlings or 11.1% were imported, mainly from Italy, France and Egypt. Thereafter, the plan was designed to produce about 56,000,000 local seedlings between 1976 and 1980.

c. Onion Storage Project.

This project was designed for the establishment of refrigerator storage to preserve onions, because the country consumes large quantities of green and dry onions which form a very important ingredient in the Libyan diet.

Thus, the demand for onions is very high the year round. Onions become very scarce during the off-season and consequently the fluctuate accordingly. For example, during the harvesting season dry onions cost about LD 0.040 (\$0.12) per kg (at 2003 prices); however the price rises abruptly from L.D. 0.040 to LD 0.200 (\$0.60) one month after the harvesting season to LD 0.400 (\$1.20) per kg just before the next harvesting season. The main reason for the cost fluctuation is because the dry onions, if not stored properly, deteriorate quickly after harvesting. Hence, the farmer has to sell them at low prices. Consequently, this project was created to preserve onions in refrigerators. The government would buy them at a reasonable price and then they would be marketed when they were most needed at a reasonable price. If this project succeeded, the country would therefore not have to import only onions after 1980.

d. Beehive Project.

The target of this project was to increase honey production from 350 tons in 1975 to 600 tons at the end of the plan in 1980 (See Table 2.16). In order to reach self-sufficiency in honey production, the project was to import 55,000 beehives and 8,500 hive boxes. In addition, to 2000 queen bees of excellent varieties would be imported by the end of the plan.

All the above-mentioned beehives would be given freely to farmers in the agricultural settlements projects, and at nominal cost for the private sector.

e. Plant Care and Pest Production.

The transformation plan was also designed to exert more efforts and allocate sufficient funds for the plant protection from agricultural diseases and pests. Certain measures had to be taken in order to fulfill the project objectives, such as the wide usage of the most recent insecticides that money can buy throughout the country,

The implementation of most advanced tools and machinery for spraying the effected plants, including the use of light aircrafts, and the support and encouragement of the research on plant disease and their best cure and treatment.

This project, however, is mainly designed for the private sector, since the public sector is well cared by the government agencies from the start.

f. Palm Trees Development Programme.

Dates were and to some extent still are the main stable foodstuffs for many people in the rural areas, particularly in the remote desert oases. The oil impact gave a strong pushback to the life of the palm trees, since many farmers abandoned their farms and migrated to the oil fields and urban centres, seeking easies and more lucrative jobs.

According to the 1974 agricultural census in Libya, the number of palms was 4,600,000 trees, of which only 67.4% were productive palms. Since the decline of the palm plantations and date production after the discovery of oil, no exact data has been recorded since for date production. But the production of dates in Libya during its best years prior to that time amounted to between 30,000 and 70,000 tons per year. Consequently, this programme was designed to develop the existing palm groves,

as well as to increase their numbers by importing better varieties and distributing them among the farmers in all parts of the country at nominal cost and sometimes free of charge.

One of the main objects of the palm trees programme was to train farmers in modern and scientific methods of raising and maintaining the best varieties of palm trees for good quality and abundant production.

For the first time, the revolution showed great concern for the development of palm trees. Hence, 8 new agricultural centres were established within the context of the five-year transformation plan between 1975 and 1977, mainly in the desert oases where palm groves were mostly grown.

The target was to import 160,000 palm seedlings during the period of the plan, 1976-1980. Most of these were to be distributed among farmers in the private sector, and the rest would be planted on public lands especially in the agricultural settlements. Modern machinery and equipment for date processing and preserving were to be introduced to guarantee foreign markets for surplus production, because the presently available preserved dates were not desired even by Libyans, particularly in the urban centres. Production of date by-products such as syrup, date paste and alcohol were to be increased, as well as foreign markets found for packaged dates, especially those of good quality.

g. Forestry and Afforestation Programme.

One of the main goals of the agricultural development planning in Libya was the expansion and development of forestry plantations around the urban centres and agricultural lands, mainly for the protection of the cities and agricultural lands from the gusty desert Ghibli (sirocco) winds, which usually blow from southerly directions sweeping the sand dunes on the coastal areas. According to the plan the forest plantations would also protect the land from soil erosion by wind and water, which posed a serious threat to agriculture in many parts of the country.

The proposed forest plantations were also designed to stabilize the movable sand dunes around the big cities and the agricultural lands. The target was to produce 161 million forest seedlings during the plan period, 1976-1980. The seedlings planted during the three-year development plan, 1973-1975, amounted to 67 million plants, distributed between both the public and the private sectors.

The plan also intended to stabilize 19,350 ha of sand dunes and to plant an area of about 55,790 ha of semi-arid lands, mountain ranges and other various landform types with forest trees. The Rangers Training Institute was given great support and development in order to assist in the development of forestry. The objective was to graduate 70 well trained rangers per annum. However, the number of graduates by the end of the plan of about 350 persons could hardly supervise and take care of the widely spread areas of forest plantation throughout the country.

h. The Agricultural Machinery Programme.

By the completion of this programme, two main objectives were to be achieved the first being to secure the introduction of the machinery used by most of the farmers, particularly in ploughing and harvesting, in the dry farming lands and in every county and district. The other objective was to guarantee the expansion of public cultivated lands.

The plan was also designed to encourage private farmers to use machinery in their farming practices at a nominal rental fee. Consequently, the target was to increase the numbers of agricultural tractors from 14,159 in 1975 to 37,600 in 1980, combine harvesters from 3207 in 1975 to 4580 in 1980, and hay compressors from 1333 in 1975 to 2400 in 1980.

The existing number of garages for the repair of agricultural machinery amounted to 18. According to the plan, these would be increased to 37 garages by the end of the plan. The new garages were to be created in areas where agricultural machinery was heavily used.

i. The Agricultural Extension Programme.

The target plan of this programme was to improve and expand extension services and information to as many farmers as possible throughout the country. One of the most important tasks for extension personnel was to train farmers in modern methods of farming and in the implementation of modern techniques in the use of agricultural machinery and equipment, as well as the introduction of properly selected seeds and the best varieties of fruit seedlings.

In addition to the education and agricultural information to be provided to farmers, this programme also aimed to promote agricultural output and animal production.

The plan was also designed to support and increase the number of extension workers.

This was to be accomplished by providing modern equipment and tools, as well as furnishing them with fleet cars in order to facilitate their work.

j. Cooperative Societies Programme.

This programme was aimed at encouraging and supporting 200 agricultural cooperative societies during the plan period of 1976-80. The support will be in kind, machinery, equipment, seeds, and seedlings. In addition, the co-ops would get administrators working for them but paid by the government. Some of the newly established co-ops would get free housing for their offices and garages for machinery alongside the extension personnel offices in various parts of the country. This situation was intended to create better understanding and to establish good relationships between both agencies for the benefit of agricultural development and the welfare of farmers.

k. Storage and Marketing Programme.

Cereal production in Libya was estimated at about 323,000 tons, in 1975 of which there were 107,000 tons of wheat and 216,000 tons of barley (See Table 2.18), whereas local consumption in the same period reached about 607,000 tons, of which 351,000 tons were wheat and 256,000 tons were barley. Thus, an additional 251,000 tons of wheat had to be imported (See Table 2.14). Consequently, government policy was to safeguard the supply of basic foodstuffs (mainly grains) for a period of at least

six months. Hence, imported quantities of grains had to be stored in silos until needed.

The storage capacity in 1975 was not able to house the imported grains. Therefore, the target was first to complete the construction of unfinished silos from the previous development plan, 1973-7 and secondly, to erect several new silos in various parts of the country. In addition to these two aims, the plan was designed to enlarge the capacity of existing silos so that upon completion of this programme silo capacity would reach about 240,000 tons of grains in 1980.

The plan also included the construction of 18 grain stores in several locations with a total storage capacity of 75,000 tons. Since imports and exports of all agricultural commodities as well as all other commodities had become a governmental monopoly, the marketing of cereals would be undertaken by public companies and agencies, in addition to the agricultural consumer's cooperative.

L. Agricultural Roads Programme.

Transportation facilities play a very important role in agricultural development and the welfare of the rural community. However, it is well known that when there are good roads, farmers find it easier to market their products. This would, of course, reduce expenses and consequently bring more profit to the farmers.

The farmers could also easily transport their machinery and farm needs good roads. Thus the plan was designed to build 1000 km of agricultural roads in several agricultural areas in different parts of the country. This programme was also given

the responsibility of completing unfinished roads which were initiated during the three-year development period, 1973-1975.

m. Agricultural Credit and Assistance Programme.

A large sum was allocated in the Five-Year Transformation plan for this programme to support and expand the agricultural credit and assistance to farmers in order to encourage them to follow better methods of land use and cropping patterns. The programme also encouraged the farmers to obtain agricultural machinery and farm equipment to improve farming practices and agricultural output. The credit and assistance programme consisted of four main projects:

i. Long-Term Credit Project.

The existing facility for agricultural credit in Libya seemed to be the only one of its kind in the world. Here, farmers could obtain credit by following very simple and quick procedures after submitting applications for credit, which were also free of expenses or interest charges. In many cases, the government never redeemed its credit from farmers. The credit period of the long-term project was to last for 25 years, where the first payment became due five years after the date the credit was granted.

The main objective of this project was to encourage farmers to reclaim and develop new or virgin lands, drill wells, dig cisterns, construct barns and storage, fence farms and prepare soil for farming.

ii. Assistance Project.

Through various agencies, the government committed itself to granting farmers generous financial assistance during disastrous events affecting the agricultural production or the land.

The assistance project included also partial payment for the purchase of machinery, farm equipment, seedlings, seeds, fertilizers, insecticides and water pumps. The amount of government assistance reached in most cases up to 50% of the original prices. However, the bulk of agricultural credit was undertaken by the Agricultural Bank and to a certain extent the Council for Agricultural Development.

iii. Concentrated Animal Feed Project.

This project was aimed at encouraging private farmers to raise more animals and improve their products by means of providing them with proper feed of concentrated forage crops and grains. The project target was to increase the imports of the concentrated animal feed from 96,670 tons in 1975 to an average of 80,000 tons per year during the plan period, 1976-1980.

The imported concentrated animal feed was to be subsidized by the treasury. The farmers would pay only about one quarter of its original cost.

iv. Subsidy of Field Crops Project.

In order to encourage farmers to produce more foodstuffs, particularly wheat, barley and olives, and to secure adequate farm incomes, the government had committed itself to buying any surplus of agricultural products at relatively high prices compared to existing market prices. Thereafter, these agricultural commodities would be sold to the public when they were most needed at comparatively low prices compared to market prices.

n. Statistics and Research Project,

The development and improvement of agricultural production and productivity and animal breeding depend entirely on the results of researchs and experiments carried out by scientists, specialists and experts. Consequently, the target of this project was to support and develop the Institute for Agricultural Research and any other similar institutes or organizations working for agricultural development.

The support of the Institute of Agricultural Research was aimed at encouraging scientists and researchers to perform better and more successful schemes of field experimental and scientific research in the various fields of the agricultural sector.

Agricultural statistics have a very important effect on the development of agricultural planning. Accurate and complete datas is essential in the design of any agricultural development plan. However, statistics in Libya or in any developing country are in most cases not reliable for reasons beyond the capability of those countries. Statistical data is often not correct, even in official documents. For example, the estimates of agricultural production in 1972, on the basis of which the three-year

development plan and subsequent five-year transformation plans were drafted and implemented, appeared different from one text to the other. (See Tables 2.7, 2.8 and 2.14). Therefore, more care was to be taken in the support and development of the Statistical Department in the Secretariat of Agriculture and Agrarian Reform. The Statistics Department should be fed with experts in statistics, well-trained administrators, personnel and well-trained workers in the field for collecting data for future agricultural censuses and the periodical random collection of statistics for research and academic study.

o. Water Resources Project.

Water resources for irrigation are vital and a decisive factor in agricultural development in Libya. In the past, the investigation and drilling of wells for irrigation were carried out by the Secretariat of Agriculture and Agrarian Reform. Since the establishment of the Secretariat of Dams and Water Resources in 1975, this was undertaken by the latter secretariat.

p. Agricultural Education and Training Programme.

The educating and training of boys for work on agricultural land is very important for an agricultural country like Libya. However, the lack of technicians and skilled labour in the agricultural field was and still is one of the main obstacles to agricultural development in Libya. In order to overcome this problem for the execution of the huge agricultural development plans of 1973-75 and 1976-80, the Libyan government had to rely on foreign manpower and particularly experts,

technicians, skilled labourers, extension personnel and workers mainly from Egypt and Tunisia.

To safeguard manpower for the newly established agricultural settlements and agricultural production projects, the plan was to expand and develop agricultural education by increasing the number of agricultural institutions. This would then increase the numbers of graduates from 1430 in 1975 to a total of 5600 graduates by the end of the plan in 1980.

Another aim of the plan was to establish 15 Agricultural Training Centres with a capacity ranging between 100 and 120 trainees per centre. These training centres were to be established in various locations in rural areas throughout the country. The training programmes in these centres would run for one year only, after which the trainee would receive a diploma. Students who graduated from elementary and preparatory schools would be accepted in these centres.

q. Wadis Reclamation and Development Programme.

This programme undertook responsibility for reclaiming and developing several selected wadis, including the following projects:

- i. Wadis under construction, such as Wadi Ben Jaw-Wad, in the central part of Sirt coast and wadis of the Tubruk coastal area.
- ii. Wadis under study and ready for execution such as Wadi Libdah (Leptis Magna) and Wadi Suk El Khamis.
- iii. Wadis under consideration and study. These were the Wadis of Et-Tair, Bumsafir, Al-Injeel, Al-Mahbul, An-Naga and Algala'a in Darna district.

In addition 16 other wadis were situated between Mizda and Bani-Walid: Um Es-Sidir, Sowf Ej-jeen, Ras Et-Tabil, Al- Amoud, Al Athlah, Al-Ass, Marseet, Um Er-Ramil, Waseeq, Taghigget Fazzet, Jalilah, Wamis, Faisal, Mizzi and Fruiten.

4. Agricultural Development Council:

The Agricultural Development Council was established in order to supervise the execution of integral agricultural projects, developing new agricultural areas and transforming them from fallow land to agricultural land. The purpose this process was to reach self-sufficiency in agricultural production, meat, dairy products and eggs, the protection of natural resources such as water, soil and forests and the creation of residential areas in the new agricultural regions of the Jefara Plain, Jabal El-Akhdar, Fazzan, Kufra, Es-Sarir, and As-Sulul El-Khudur regions that was added recently.

The Agricultural Development Council undertook the execution of economic and social transformation plans in the country and it assumed the task of adding of agricultural areas that were on the verge to equal the area being farmed before the ternary development plan. The total area of farmed lands in 1972 was about 3,647,000 hectares, it covering several regions of Libya. These lands were characterized by the availability of water and good soil. Consequently, the purposes of the comprehensive plan could be realized considering the spatial fact. Thereupon, agricultural regions were performed in the coastal regions, whether in the Jefara plain of Jabal El-Akhdar plan, and internal regions such as Kufra, Es-Sarir and Fazzan regions. Also, the As Sulul Al-Khudur region, which was characterized by many

wadis was developed. Pursuant to this work, new residential estates were founded to attract inhabitants instead of them emigrating to the main towns on the coast such as Tripoli and Benghazi.

Diverse agricultural industries could also be performed in these regions when sufficient agricultural production is available. And effectively, the Implementation of Some transformation factories start, such as, tomatos factories in Sabha and Darj, factory of vegetables and fruits packaging in Ma'amurah at Jefara plain.

Undoubtedly, the agricultural production of these projects will be the main supplier for manufacturer and others in the future.

5. Programmes of the Long Term Integrated Agricultural Development Plan:

The first quinquennial transformation plan included about 43 projects for integrated agricultural development, distributed around the country at Jefara Plain, Jabal Al-Akhdar, Fazzan, Kufra, Es-Sarir and As Sulul Al-Khudur. There were 35 projects for the plantation of crops, vegetables and fruits, 7 projects for the development of pastures and the plantation of forests, and one project for grains sowing on a area of about 100,000 hectares at the Jefara Plain.

These long-term programmes aimed at the promotion of a total area of 1,370,816 hectares distributed as follows:

a. Reclamation and fruit promotion of 437,016 hectares for crops, vegetables and fruit plantations. 155,143 hectares of this area was allocated for irrigated agriculture, and about 281,873 hectares for unirrigated agriculture. This area was to be divided

into 12,619 farms with most being in possession of the cultivators, in addition to some productive areas remaining wasteland waiting for exploitation by the project administration.

b. Reclamation and promotion of 833,800 hectares for the promotion of pastures and the plantation of forests.

c. Reclamation and promotion of 100.000 hectares for grains sowing at the Jefara plain, in addition to the other fields, of an area of about 376,900 hectares. This area was divided as follows:

i – 66,900 hectares in the Jefara Plain.

ii – 170,000 hectares in the Jabal Al-Akhdar.

iii – 5,000 hectares in the Fazzan.

iv – 35,000 hectares in Kufra and Es-Sarir.

v -100,000 hectares in As Sulul Al-Khudur Projects.

Aside from the above-mentioned areas, the agricultural development projects objected to the performance of plantation activities, erection, and training and agricultural production development in the regions allocated for this purpose. These programmes show the magnitude of works objected for execution, in order to realize the complementarily in the horizontal agricultural extension for increment of production quantity.

The pervious table shows that total integral agriculture area in the five regions was about 437,016 hectares, of which 155,143 hectares were irrigated or 35.5%, of total and about 121, 5673 hectares area of unirrigated or 64.5% of total lands area in the five regions.(See Table 2.19)

The plan aims also at the construction of 12,619 agricultural farms, and handles them of farmers. The area of forests and pastures is of about 833,800 hectares in the Jefara plain, Jabal Al-Akhdar and As Sulul Al-Khudur regions only. Also, grains sowing project embraces of an area of 100,000 hectares to be implemented in the Jefara Plain.

Aside of these agricultural areas and their distribution on the five regions, the plan objects to drill 3485 well for the irrigation development project. Besides, 3101 km of agricultural roads and 8386 km of dirt and unpaved roads were implemented. All this to erect zones and to facilitate the settlement and development in the new lands. (See Table 2.20)

The project would also undertake the training of about 19,316 farmers for agricultural activities, machines use and reclamation of lands, besides the illiteracy elimination.

After training these farmers, farms were to be distributed on them while they are contributing in agricultural works in the projects since the implementation. The plan stated the development of animal production development, whereas it introduced the breeding of 260,778 sheep 12,696 cows. The formation of 28,350 beehives, and about one million head of poultry. (See Table. 2.20) shows the distribution of these programmes in the five regions.

It is noticeable from (See Tables 2.19 and 2.20) that, the agricultural housing unit's has decreased in (See Table. 2.20) of about 208 units, this is, and however, which is due to the inability of the project to execute all its requirements.

5.1. The Achievements of the Economic and Social Transformation Plan 1976-1980 In The Agricultural Sector.

The first quintet transformation plan, 1976-1980, realized many achievements concerning the agricultural sector and agrarian reform.

The statistics show that in the area of land reclamation large amounts of arable land were reclaimed and several integrated agricultural and productive projects were established. In addition, thousands of farms were established and distributed to farmers. A programme was also designed for soil conservation and the protection of natural resource i.e. soil and water.

The agricultural production had also stepped a great deal from its original ones, prior to the initiation of the development of the agricultural plans. This has come due to the improvement of the standard of living and the promotion of the food sense.

Table 2.21 shows the evolution of agricultural production during the period of the plan between 1976-1980. The production of agricultural commodities fluctuates from year to year. For example, wheat production in 1976 increased by about 55,000 tons 1975, while in 1977, it decreased by about 73,000 tons. However, in 1978, 79, and 80 productions increased to 99, 000 -110,000 and 141,000 tons respectively.

This case is also applicable to the production of barley, olive vegetables, olive oil, dairy and other agricultural products. Comparing agricultural production prior to the initiation of the plan with the last year of the plan in 1980, we find, despite the difficulties that, faced the application of the plan's projects, the drought conditions, and the irratic rainfall, during most of the plan years (1976-1980). In addition, to the

strict application policy for water conservation, by means of decreasing the irrigated lands, which were invested in the production of tomatoes, vegetables, and peanuts. Nonetheless, considerable advances can be noticed concerning land reclamation and agrarian reform such as:

- i. Increased wheat production of about 46.8% from about 75,000 tons in 1976, to about 141,000 tons in 1980, this quantity of increased wheat has, however, had participated in realizing self-sufficiency by 33.3%.
- ii. Increased fruit and olive production from about 248,000 tons of fruits and 312,000 tons of olives in 1980, which accounted for about 98% of local demand.
- iii. Increased vegetable production from 564,000 tons in 1975 to about 659,000 tons in 1980. This realizes about 59.6% of local demand.
- iv. Increased meat production from about 44,300 tons in 1975 to about 59,000 tons in 1980. This amount covers about 45.8% of local meat consumption.
- v. Increased dairy production from 87,000 tons in 1975 to about 110,000 tons in 1980. This realizes about 48.9% of local needs.
- vi. Increased alimentary eggs production from about 10,300 tons in 1975, to about 15,700 tons in 1980, representing 100% self-sufficiency. (See Table 2.21)

In addition to other important achievements listed are as follows:

- a. An area of about 99,758 hectares of irrigated land was reclaimed and an area of about 368,073 ha was developed as pasture land.
- b. About 8809 farms were established and distributed to farmers.
- C. An area of about 151,000 ha of land was afforested the number of sets or seedlings distributed reached about 323 million sets of pasture woods, which were planted indifferent agricultural protects.

- d. 17 million fruit trees were planted during the plan period, and about 504,000 sets of palm trees were planted in different parts of the country.
- e. Several dams and dikes were built at main wadis (intermittent valleys) such as: wadi Ka'am, east of Al-Khoms city, with a storage capacity of about 110 million m³, wadi Darna-Bu-Mansour Dam, with a storage capacity of about 22 million m³, wadi Ghan, wadi Zarit, and wadi El-Mjenin in the Jefara plain.
- f. The number of agricultural cooperative societies increased from 179 in 1975 to 305 in 1985.
- g. The number of farms distributed reached 8809 farms.
- h. 24,000 ha of irrigated land were sown with wheat during the season of 1979-1980, as were about 248,000 ha of dry-farming land. The area sown by barley in the same season was about 9700 ha of irrigated land and about 27200 ha of unirrigated land. This realized a total crop production of 141,000 tons of wheat, and about 71,000 tons of barley. A great development has been occurred in the agriculture structure, as a result of the realized fulfillments in the whole programmes, and the projects of the land Reclamation and the Agrarian Reform Sector, during the transformation plan, 76-1980, which had participated with large share in realizing self-sufficiency in grains, fruits, vegetables and animal product. Beside the ideal utilization of the natural resources such as: soils, water, and forests. In addition this plan has successfully created new settlements in the rural areas with centres able to provide the means of realizing a reasonable standard of living for the chosen farmers.

The new settlement centres consisted of modern houses for the farmers and their families. In addition they provided services such as markets, schools, dispensaries, and professional institutions.

The farmers had to join training programmes concerning the usage of modern machinery and equipment for agricultural activities, and also learning the application of modern methods and technologies in farming.

Indication concerning the Agricultural Land Reclamation and Agrarian Reform Sector has had established a strong economic base playing a major and important role in executing the economic and social development projects, and realizing its long-term aims.

The quintet plan of 1976-1980 produced high standards of experienced Libyan personnel in the fields of planning, executing and supervising in most of the branches of the agricultural activities concerning, the agricultural projects, which were included in the said plan, in order to guarantee the success of the plan, which is considered

In all its projects but, a continuation of the long-term strategy in the area of the "green agricultural revolution". It is worth mentioning, however, in this context, that almost all of the agricultural development plans and projects, were set-up, designed, executed supervised and appraised by foreigners whom haven't had any previous relation or knowledge of the country, because they were agnostic about its, natural environment and human conditions. All these circumstances, and others have had caused, the expatriate's committee, to commit many mistakes, that, led, its effect to the failure of the executed projects on one hand hindered the general benefit of the country from these projects on the other hand.

6. Allocations for the Agricultural Sector.

The original sum allocated to the agricultural transformation plan was L.D. 1,226,596,000 (\$434,486,800) or 17.1% of the total budget designed for the comprehensive economic and social transformation plan. However, this sum was expected to be spent on horizontal and vertical agricultural development and the creation of agricultural settlements during the plan period between 1976-80. The large sum, which was allocated for this agricultural development plan, depicts the importance of the agricultural sector, as an essential factor in the development of the national economy, in addition to the oil sector.

The share of the Agriculture and Agrarian Reform Programmes in this budget accounted for LD 445,296,000 (\$12, 468, 188, 00) or 36.3% of the total amount allocated for the agricultural sector (See Table2.22).

Table 2.23 shows clearly that animal husbandry and land reform gained the largest share (33.9%) in the allocated budget for Agriculture and Agrarian Reform as represented by 21.3% and 12.6% respectively.

The allocations planned for the fiscal year 1976 was (LD 111,086,000 \$3111, 040,800) or 24.1% of the total budget. However, before the end of the first year of the plan's execution 1976, the People's General Congress issued on December 28, 1976 the Law no. 104 amending the allocations for the whole economic and social plan 1976-80. Consequently, the allocation for the agricultural sector increased from LD 1,226,596,000 to LD 1,270,029,000 (\$556, 081, 2000) a percentage increase of 3.5% (See Table 2.22).

Despite the increase in the allocation for the agricultural sector, the Agricultural and Agrarian Reform Programmes have, in fact, decreased by 8% from the original allocated budget. This decrease was attributed to the fact that the hydrological studies and research programme was transferred at the end of the fiscal year 1976 from the Secretariat of Agriculture and Agrarian Reform to the newly established Secretariat of Dams and Water Resources.

APPENDIX B:

Results of the Questionnaire/Interview study Conducted in the Agricultural Settlement Projects in the Jefara Plain:

Questionnaire forms were distributed to farms of each project periods. Field investigations were also conducted mainly with project personnel and selected farmers who owned medium or poor farms.

The total number of questionnaires distributed was 1250. The number of responses only 532: 177 from al Garabulli / Wadi Ar-Raml, 125 from Al Hira, 120 from wadi Al Haye and 110 from Bir Tirfas.

1. The Present Land Use:

The total surveyed areas for reclamation and land reform in the above mentioned agricultural land settlement projects were about 54,321 Ha. Out of the area designated of about 59,280 Ha.

The reclaimed and developed areas for the establishment of new agricultural land settlement projects were as follows: Al Garabulli Wadi Ar-Raml project embraces of 24500 Ha. As it was designated in the plan, Wadi Al Hirah embraces of 5280 Ha. Out of the designated area of 5610 Ha. Wadi Al Haye area is about 12000 Ha., as it was designated, Wadi Abu Shaibah area is 1371 Ha., out of 15000 Ha. And Bir Tirfas area of about 7170 Ha. As it was designated. (See Table B.1).

The land use types were those, which were virtually planned for the period, 1984-1985. During the period of the field investigation and surveying were conducted and the

questionnaires were carried out in most of the agricultural and settlement projects, in the area under consideration.

The above mentioned land and its types of land use were divided into 2366 farm units, of which 50 farm units were in the Wadi Ar-Ramil project area, 1000 farm units were situated in the Al Garabulli project area, 120 farm units were in Wadi Al-Mjinin, 478 farm units were in Bir Tirfas, 300 farm units were in Wadi Al-Hira and 418 farm units were in Wadi Al-Haye/Abu Shaibah.(See Table B.1)

Table B.1: Land use Reclaimed for Agricultural Settlement Projects in the Jefara Plain

Project name	Designated area/ha	Reclaimed/ developed area/ ha	Percentage
Al-Garabulli	24000	24000	100
Wadi Al-Hirah	5610	5280	94.1
Wadi Al-Mjinin	5000	4000	80
Wadi Al-Haye	12000	12000	100
Wadi Abu Shaibah	5000	1371	27.4
Bir Tirfas	7170	7170	100
Wadi Ar-Raml	500	500	100
Total	59250	54321	91.7

Source: Execative committee of the Jefara Plain Tripoli, 1985 pp. 30 , 114, 115, 118,-119, 126-127, 30- 3, 136-137, 140-141
 -Field investigations & questionnaire.

The present land use types were those, which virtually planned for the season 1984-85 during the period when the writer had conducted the field studies and carried out the questionnaires in the area under consideration.

Table B.1 shows that about 91.7 of the reclaimed and developed lands were designated for the agricultural usages. The agricultural land use types were arranged according to the following order:

- (1). Irrigated land. Occupied 12805 ha. (23.3% of the designated agricultural land or 25.3% of the area reclaimed) (See Table B.2).
- (2). Non-irrigated land or dry farming land occupied 37715 ha. (68.3 of the designated agricultural land and 74.7 of the reclaimed area).

Table B. 2: Reclaimed Areas for Irrigated & Unirrigated Land Use.

(In hectare)					
Project name	Irrigated	Unirrigated	Total	Target area	No. of farms
Al-Garabulli	3300	207000	24000	24000	1000
Wadi Ar-Raml	500	-	500	500	50
Wadi Al-Mjenin	1200	1800	3000	3000	120
Bir Tireas	2390	4780	7170	7170	478
Al-Hirah	4512	888	5400	5400	300
Wadi al-Haye/Bushepa	903	9547	10450	15135	418
Total	12805	37715	50520	55205	2366
%	25.3	74.7	100	-	-

Source: Calculated From The Questionnaires.

2- Farm types

(A) Irrigated farms of 10 Ha.

Each farm unit which comprised of 10 ha. Mostly have occupied the best soil types in the areas under consideration.

Accordingly, the whole areas of this type were devoted to irrigation

Each farm unit comprised 10 ha. It was divided into 10 fields, and each field was divided into parcels. Thus, the prevailing arrangement for each farm was as follows:

- (1) 4 ha were devoted to the cultivation of wheat and then with legumes.
- (2) 2 ha were cultivated with barley.
- (3) 2 ha were cultivated with fodder crops.

(4) 1.5 ha were cultivated with fruit trees and the space in between was cultivated with broad beans, which were used mainly as fertilizers.

(5) 0.5 ha comprised the area occupied by the house, yard, and the growing of vegetables for the farmer's family's consumption.

In addition to this arrangement, palm trees were planted along the farm's unpaved roads, as well as a row of forest trees 100 meters wide surrounding the periphery of each farm unit and in the areas adjacent to the dynamic sand dunes. The forest trees were considered the main wind breaks protecting the agricultural fields in each farm from the gusty winds which frequently blow from the south (Ghibli) and occasionally from the west and southwest during the winter months.

The forest trees which were planted during the initiation of the projects in 1973 have now mostly grown and stand high, ranging between 2-5 meters above the ground.

The areas allocated for fruit trees were planted with 3,459,171 fruit seedlings of mainly grapes, peaches, plums, oranges and pomegranates. Most of these produced small quantities of fruit in the season 1976-77. However, their production was expected to increase until they reached their full production after 5-8 years. In 1985 all fruit trees were productive. In addition to 1,972,480 forest trees (See Table B.3).

The total cost of this farm type ranged between L.D. 34,000 and L.D. 53,000.

Table B.3: Fruit And Forest Trees Planted In The Project Areas by 1980.

Project name	No. of fruit trees	%	No. of forest trees	%
Al- Garabulli	1,835,982	53.3	16,250	0.8
Wadi Ar-Raml	40,820	1.2	343,400	17.4
Wadi Al-Hirah	796,321	32.0	575,000	37.9
Wadi Al-Mjinin	494,500	14.3	748,350	29.2
Bir Tirfas	265,748	7.7	7,480	0.4
Wadi Al-Haye/Abu Shaibah	25,800	07	282,000	14.3
Total	3,459,171	100	1,972,480	100

(B). Irrigated farms of 6 ha.

Farms comprising 6 ha of irrigated land occupied the best available cadastral land classes I, II, III and IV lands in the area between Al Garabulli, Gasir Khiyar and Al Allous. Each farm unit was divided into eight fields. The areas for agricultural production in each farm were as follows:

1. 2.25 ha were devoted to the cultivation of wheat, then with legumes.
2. 0.75 ha for the cultivation of vegetables.
3. 0.75 ha for the cultivation of fruit trees (including the farmhouse).
4. 2.25 ha for the cultivation of fodder crops.

Each farm unit was surrounded by windbreaks of two or more rows of mainly eucalyptus, pine, Carolina and acacia. The fields of each farm were protected by one row of windbreaks of the same species.

The cost of this farm type ranged between L.D. 31,000 and L.D. 53,000.

(C) Farms with Irrigated and Dry Farming Land

Each farm unit covered between 10-26 ha. 3-6 ha of each farm unit was irrigated and between 10-20 ha was for non-irrigated or dry farming.

This type of farm contained almost all types of soils and cadastral land classes i.e. land classes from I to VII.

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(1) The 3-6 ha of irrigated land was divided into eight fields, cultivated as follows:

a. 1.125-1.875 ha was designated for the cultivation of wheat.

B. 1.125-1.875 ha was designated for the cultivation of fodder crops (i.e. alfalfa and berseem).

c. 0.375-0.625 ha was designated for the cultivation of fruit trees, including oranges, grapes, plums, apples, pomegranates and figs, and included the farmhouse.

d. 0.375-0.625 ha designated for the cultivation of vegetables such as tomatoes, potatoes, onions, lettuces, eggplants, chili peppers and watermelons.

(2) The dry area of 10-25 ha was divided into six fields cultivated as follows:

a. The area designated for the planting of olive trees ranged between 3.50 ha to 7.75 ha. The olives were integrated with almonds.

B. The area designated for the planting of almond groves ranged between 2.0 ha and 4.50 ha.

c. The area for fig groves ranged between 1.5 ha and 3.75 ha.

d. The area allocated for the sowing of barley was between 2.0-4.50 ha.

e. The pasture land ranged between 1.0 ha and 4.50 ha

The average cost of this farm type varied between L.D. 55,000 and L.D. 61,000.

However, the sizes of the farms and fields varied throughout the projects, and they did not appear as planned. This was because of variations in land surface, soils and land classes, which differed from the data in the survey. The variation of the farm

sizes and particularities were slight in some of the farms, but in some others they were very great, particularly in the Al Garabulli farm type II. For example, in the 177 farms investigated in 1980, about 25% of the Al Garabulli farm type II investigated showed differences in size, ranging between 19-29 ha instead of 26 ha each. The variation in size was lower in the irrigated farm units. For example, in the 50 farms of Wadi Ar Ramil there were only three farms, varied in size from 2-15 ha instead of 10 ha of each.

Differences in farm size and properties were expected in farms of 3-10 ha. In some cases, the cadastral classes I, II and III in the 3-10 ha irrigated land of each farm units were found varying from 1-7 ha instead of 3-5 ha of each farm, were found in the irrigated 3 ha and 6ha farm units instead of classes I, II, III and IV. This situation created problems for the project authorities at the beginning of the project. Nothing was done to solve this problem, and the new farmers had to accommodate themselves to what they found. Most of them don't know even what was happening about this problem.

The follow-up report of December 1984 revealed that after about 12 years of agricultural practice in the Al Garabulli project, 407 farms had reached a medium stage of production. If all recommended agricultural practices were followed by their farmers these farms would reach the stage of full production after a further 3 years. There were 101 farms with below average production, which were in bad condition and were thought to need more than 5 years in order to reach full of production. There were also 20 newly established farms. These farms would need a period between 10 – 15 years to reach full productive state.

The following are some clarification on the farm types in the said projects.

Wadi Al-Mjinin project embraces of 120 farm units, each farm unit consists of 25 Ha. Out of this, about 10ha irrigated land and the rest is dry-farming land, Bir Tiras project embraces of 478 farm units each farm unit consists of 15 ha with 5 ha of irrigated land and 10 ha assigned for dry-farming, Wadi Al-Haye embraces of 418 farm units. Each farm consists of 25 ha with 2.16 ha of irrigated land and 22.84 ha assigned for dry farming.

It is worth mentioning that although Abu Shaiba project was always classified together with Wadi Al Haye, it used totally dry-farming. The Al Garabulli project 100 farm units of irrigated land each consisting of 6ha, and 900 farms consisting of 26ha where each farm was divided into 3ha of irrigated land and 23ha of dry-farming land. The Wadi Ar-Raml 50 farm units each consisting of 10ha of irrigated land. The Wadi Al Hira project had 300 farm units each consisting of 10ha irrigated land. In addition to the experimental farm which embraced of 312 ha of irrigated land use besides to 888ha. Of dry _ farming land use, which will be divided into land settlement farm units if, however, irrigation water is available

3. Cropping Patterns

The selections of crops to be cultivated were expected to be carried out according to the designated plan. But after the first or second year, the farms were mostly cultivated by according to their farmer's desires, or sometimes what was thought to be successful in other farms or in other areas.

In general, the cropping patterns in the projects areas were almost the same as the general patterns of farming in the coastal strip of Libya. Winter crops of cereals (wheat and barley), winter and summer crops of vegetables, and tree crops were the major crop patterns in the tree areas under consideration.

For a better understanding of the cropping patterns, they are discussed according to farm type as follows:

A. Farm Types of Irrigated 10ha

The general features of the cropping patterns in these farms were as follows.

The farm unit was normally divided into 10-12 fields and lots. Each field or lot varied in size from 0.1 to 3 ha depending on the type of crops and the growing season. However the cropping patterns appeared in some of the investigated farms and were as follows:

- (1). 3 fields were allocated for the sowing of wheat.
- (2). 2 fields for the growing of barley.
- (3). 1 fields for the growing of fodder crops, mainly of alfalfa.
- (4). 1 field and 1 lot were planted with fruit trees (mainly oranges, plums, figs, apples, apricots, peaches, and pomegranates).
- (5). 1 parcel, which included the farmyard, was designated for the growing of vegetables.
- (6). 2 fields of those previously grown with wheat were planted after harvesting with legumes (mainly chickpeas).
- (7). 2 fields were left as fallow land.

- (8). 2 fields and 1 lot of the fruit trees were cultivated with legumes (mainly broad beans) during the winter season. The legumes were grown and then parried by ploughing as fertilizers for the fruit trees.

According to the farming plan for the cropping patterns, the sizes of the fields were as follows:

- a. 3 ha of the surface was designated for the growing of wheat.
- b. 2 ha were designated for the growing of barley.
- c. 1 ha were designated for the growing of alfalfa.
- d. 1 ha were designated for the growing of Berseem Hijazi.
- e. 2.32 ha of the total surface were assigned for the cultivation of vegetables.
- f. 1.68 ha were left as a fallow land.

Some of the farms surveyed in 1977 were 100% cultivated during the winter and summer seasons. Others were cultivated 50% during summer and 50% during winter. Very few farms were cultivated between 15-30% during summer and 100% during winter. However, some of the surveyed farms were not cultivated at all during the season 1976-77 because their settlers thought that the project was not helpful to them.

During the field investigation of March 1980 the cropping patterns in the Wadi Ar-Raml farms showed less variation of cultures than that was proposed in the project.

The cultures grown on the farm surface during the spring season of 1980 were mostly wheat, barley, legumes chick peas and broad beans, and fodder crops of

mainly Berseem Hijazi, while vegetables occupied small parcels of the farm surface, and the fruit trees covered less than 15% of the farm area.

B. Farm Types of Irrigated 3-6ha.

In the 3-6 ha irrigated farms the cropping patterns were slightly different from those of the 10 ha farm type. Here, each farm's area was divided into eight fields:

1. 3 fields were designated for the growing of wheat.
2. 2 fields were devoted to the growing of fodder crops, of mainly alfalfa and Berseem and sorghum.
3. 1 field was designated for the growing of fruit trees. (mainly oranges, plums, pears, figs and grapes). The farm yard was included in this field.
4. 1 field was dedicated to the growing of vegetables.
5. 1 field was left as fallow land.

According to the farming plan for the cropping patterns, the sizes of the fields were as follows:

- a. 3ha or 50% of the surface was dedicated to the growing of wheat.
- b. 0.50ha or 8.4% of the surface was dedicated to the growing of barley.
- c. 0.25ha or 4.2% of the surface was dedicated to the growing of alfalfa.
- d. 0.25ha or 4.2% of the surface was dedicated to the growing of Berseem.
- e. 1.75ha or 2.92% of the surface was dedicated to the growing to the growing of vegetables.
- f. 0.25ha was left as fallow land.

A. Farms of Dry-Farming of 10—26ha.

The cropping patterns in the 10-26 ha farm units were somewhat different from those of 10ha. The farm units comprise two types of farming practices:

1. Irrigated farming land,
2. Non-irrigated or dry farming land.

(1). Irrigated Farming Land

In the majority of farms, the irrigated area occupied between 3-6ha or about 11.5% of the total farm surface. This part of the farm was divided into eight fields. The proposed cropping patterns and the sizes of the irrigated part of the farm were as follows:

- a. 3 fields were allocated for the growing of wheat.
- b. 3 fields were allocated for the growing of fodder crops of mainly alfalfa and Berseem Hijazi.
- c. 1 field was allocated for fruit trees(mainly oranges, grapes apricots, Peaches, figs, and pomegranates). The farmhouse was included in this field.
- d. 1 field was designated for the growing of vegetables.

The cropping patterns in the irrigated part of this farm type were similar to those of the 6ha farm type having the following arrangement of crops:

- .i 1.5-3 ha of the surface was devoted to the sowing of wheat.
- .ii 0.25-0.5 ha of the surface was devoted to the sowing of barley.
- .iii 0.25-0.5 ha of the surface was devoted to the cultivation of alfalfa.
- .iv 0.25-0.5 ha of the surface was devoted to sorghum fodder.
- .v 0.75-1.5 ha was dedicated to the growing of vegetables.

According to the field investigations of 1980, most of the proposed cultures were implicated in some of the completed farms but. However, because of the large area of this farm type, the farmer and his family were often not able to cultivate the whole area designated for irrigated field crops, in addition to the planting and taking care of seedlings. Thus, very small parcels of land in each farm were cultivated with mainly alfalfa, corn, wheat, tomatoes, broad beans, eggplants and chick peas.

(1) Farm Types on Dry Farming Land

The non-irrigated or dry farming parts of farms were mostly devoted to the growing of barley during the period October, 1980 and Jun1981. However this situation continued up to the year 1985 surface of the dry farming part was divided into six fields the arrangement of these fields was planned as follows:

(a) 3 fields were designated for the planting of orchard trees. One field was dedicated for planting olive trees. Another field was allocated for the planting of fig groves; the third field was designated for the planting of almond groves. Vines were also integrated with the almond and fig trees.

(a) 2 fields were designated as pastureland for animal grazing. However, the sheep programme was terminated by the project authorities. Nonetheless, all farmers owned herds of sheep.

(C) 1 field was designated for the sowing of barley; the cropping patterns and the size of fields were set according to the following arrangement.

- .i 4 ha or 16% of the surface was devoted to the sowing of barley. The area devoted to barley depended on how much barley was needed for animal

feed. However, barley was considered as the most desired grain for food for the rural population in Libya.

- .ii 2.0-4 ha or 20%-16% of the surface was designated for the planting of olive trees. The olives were integrated with almonds.
- .iii 2.0-4 ha or 20%-16% of the surface was designated for the planting of almond groves.
- .iv 2.0-4 ha or 20%-16% of the area designated for orchards and planted with fig trees.
- .v 2.0-9 ha or 20%-36% of the surface was left as pasture land.

According to the field investigation in 1980 the planting of fruit trees was lagging behind schedule. This was due to the fact that most of the planted seedlings had to be imported from abroad, mainly from Italy and France. In addition was the difficulty of the reclamation of the surface of the calcareous crust, where most of the orchards have been planted. According to the investigations carried out. March 1985 the number of fruit trees exceeded the plan by more than 2.5%, reaching 3,459,171 plants (See Table B.3).

4- Farm Agricultural Production:

The levels of crop productivity in the irrigated farms in all projects were almost the same, since all farm types possessed the same physical properties.

The crop productivity in the non-irrigated lands differed from one project to another. depending on the types of soils and cadastral classes, as well as the quantity and

distribution of rainfall which differs from north to south and from west to east in the Jefara Plain.

The crop yield per hectare in the irrigated farms varied from one farm to another, according to differences in the distribution of cadastral classes. For example: the crop yield per hectare ranged between 35 cubic metric tons (mtc) in land class 1, to 23 mtc in land class IV; barley ranged from 37 mtc to 25 mtc; potatoes ranged from 180 mtc to 90 mtc; tomatoes ranged from 250 mtc to 150 mtc; and Alfalfa ranged from 650 mtc to 300 mtc.

The crop yields of non-irrigated or dry-farming lands were naturally expected to be smaller compared to the crop yields of the irrigated lands. For example, the yield of barley per hectare ranged between 10 mtc in class 1 to 5 mtc in class IV; reaching about 27% to 20% respectively of irrigated crop yields.

The wheat in the dry farming lands yield did not differ too much from the barley in the same environmental conditions outside of the project areas, except that the barley can survive in areas with less favorable conditions than are suitable for the wheat.

According to the field investigations of 1980, the crop yields were drastically lower than the projected yields. For example, the average yield of wheat in the irrigated lands for the season 1978-79 ranged between 10-12mtc, for barley between 15-35mtc, for alfalfa between 10-20mtc, and for potatoes 30mtc.

These low yields in the settlement projects can be attributed to the lack of familiarity of the farmers with the physical structure and properties of their lands and with the

irrigation system (sprinklers and hydroponic tubes) as well as the improper use of fertilizers and plant insecticides.

However, it was expected that with the proper practices of land use, cropping patterns and the implication of modern machinery, fertilizers and insecticides, the yield of the crops would increase year after year, until full production and productivity was reached.

The total sum of production of all of the projects in the season of 1984–85 was about 683,269mt of irrigated wheat and 1,375,322mtc of dry farmed barley.

The average yield of fruit crops per hectare varied considerably between the irrigated and non-irrigated lands, as well as between each type of farms. This was due to differences in the cadastral soil types from one class to another and from one project to the other.

The crop yield of irrigated figs was between 65-100mtc per hectare, while non-irrigated crops it was between 25-45mtc per ha. Depending on the cadastral land classes, the crop yield of the irrigated vines was between 70-130mtc per hectare; and for pears was between 120-180mtc, etc.

The fruit trees (Table B.3) planted since the initiation of the project had not reached full productivity by 1985. In addition, data on fruit production was not collected by the project authorities because almost all farmers sold their products directly to consumers.

From the results of the 1980 questionnaires and field investigations, the yield of the non-irrigated vines ranged between 1.7-2mtc per hectare, for figs ranged between 0.75-1.33mtc per hectare, and for peaches ranged between 0.267-1.500mtc per hectare.

The low productivity of the orchards was related to the fact that this crop was for many trees the first and most of the trees were not yet productive. However, with good management and proper care, the fruit trees were expected to produce more and better quality fruit per tree than were productied in the season of 1979-80 particularly when the trees had reached their full growth between 5-8 years.

5. Livestock

According to the plan for the agricultural land settlement projects, depending on the availability of fodder crops, each farmer in the project area was entitled to get from the project the following numbers of livestock:

- A. 1 cow, usually the Freiszian breed.
- B. 20 local Berber sheep.
- C. 50 head of poultry.
- D. 5 beehives.

From this livestock the projected annual output of these animals was expected to be as follows:

1. 1,500 litres of milk, with a total value of LD 120.00.
2. 520 dozens of eggs, with a total value of LD 187.5.
3. 12 off springs, with a total value of LD 360.00.

4. 50-kg of wool, with a total value of LD 25.00.
5. 100 keg of honey, with a total value of LD 100.00.

Thus, the total value of the livestock products would be about LD 792.5(1974 values)

However, the farmers never received any livestock except for the beehives, which after two months were taken a way again. This was despite the fact that, according to the plan for the projects, every farmer should receive the aforementioned numbers of livestock immediately after moving into the new farm. Unfortunately, none of the above animals were delivered to the farmers, except a few farmers who received 5 beehives each.

The justification of the projects authorities for this was the inconvenient location of the stable, which was built attached to the living quarters of the farm house. It was thought that it would be unhealthy for the farmer's family to live close to the livestock in the stable.

One of the most important reasons for the sudden change toward the proposed livestock policy was, because, of the wariness of the projects authorities that since the new farms were mostly not in production, the new farmers might not be able to feed and take care of the proposed number of livestock. The second thought was that some of the farmers might find an excuse to sell their livestock because of the shortage of the animal feed on their farms.

Some farmers who were granted the sum of LD 300.00 as assistance in furnishing their new farmhouses simply used the money to pay back debts. Others spent the money on personal items, and some used the money to buy new cars for personal use or for hiring business instead of buying new furniture.

Some of the farmers were nevertheless very happy with this financial aid which allowed them to buy, probably for the first time, decent modern furniture for their new farmhouses.

Honey production seemed to be the most successful enterprise for the projects at that time. Probably because the locales were climatically an ideal environment for bee keeping. In addition, these areas were surrounded by many varieties of forest trees, as well as having nearby natural forest trees and bushes on the foothills of Tripoli Mountains to the south of the projects.

The number of beehives owned by the projects in 1980 amounted to about 3750 boxes and honey production for the 1978-79 seasons totaled about 130 tons.

In 1980 the beehives were transferred to the bee-production centre in Tripoli. There in 1981 the projects summed beekeeping starting with 150 beehives. By March 1985 there were 700 beehives, of which 500 boxes were distributed among 100 farmers (5 boxes each).

The total honey production from the various projects in 1984 was 250 tons. Some farmers gained an annual income from bees of about LD500, while others lost their hives because their bees had flown.

6. Farm Labour Requirements

Farm labour requirements differed from one farm type to another and from one project to another, as well as from one agricultural crop to another in the different seasons of the year. Labour requirements per hectare differ from one crop to another in the various land classes and in different seasons of the year.

Labour force requirement as proposed in the plan per hectare, ranged between 58 hours in the case of radishes to 603 hours for bell peppers (sweet peppers). The labour force requirement for the 10 ha irrigated farm type was estimated at about 1,740.8 hours per year, taking into consideration that one farmer would work a maximum of eight hours per day during 300 days per year. According to this account of labour force requirements, each farm of the Wadi Ar-Ramil farm type would require only 0.73 farmers per year.

In the A1 Garabulli farm type, the labour force requirement was estimated at about 1,044 hours per year. According to the aforementioned estimate, this type of farm would require only 0.65 farmers per year.

The labour force requirement for the 25 ha farm type, with a combination of irrigated field crops and the dry farming of cereals and fruit trees, was estimated at about 3,713 working hours per year. Consequently, this farm type would require about 1.5 farmers per year on average.

In theory, the above-mentioned estimates of labour force requirements for each farm type were plausible, but in practice were far from the reality. Most of the farmers visited during the field study of 1984 were not complaining of the bulk of work they

mere doing, and said that they were not able to cultivate the whole area which was designated in the cropping pattern, particularly in the 25 ha farms.

The planners who drew up the proposed the labour force requirements for each farm type overestimated Libyan farmers and their likely efforts, forgetting that these farmers were paid monthly allowances and usually did not care much about how much or how long they worked on the farms. Some of them left the work on the farm for the women and children and looked for other jobs outside of the projects, such as in transportation, road building, a private farm labouring.

The planning also miscalculated the numbers of working and rest days. The estimate of 300 working days per year took into consideration one rest day per week (Friday) giving 54 days per year plus 3 days for the Lesser Bairam Feast, 4 days for the Greater Bairam Feast and 4 days for the prophet Mohammad's birthday. Thus, rest days were estimated at about 65 days per year. National holidays of about 11 days and the Holy Ramadan month when all Muslims abstain from eating and drinking from dawn to dusk were not counted. Most workers in all sectors perform little work during Ramadan. Imagine farmers working on public land. How much work could they perform in this month? In addition, there is the afternoon siesta which lasts for between 1-4 hours per day especially on hot days.

The farmers also wasted too much time on project administration when they were needed most on their farms. The mornings and afternoons also involved the Libyan tea ritual, which takes between 15-60 minutes each time.

From the above account we can see how much time a farmer wastes and how much time he can devote to working on his farm.

It is also worth mentioning that the farmers of the Al Garabulli project were granted a monthly allowance ranging between LD 70 to LD 160 per farmer for the first 3 years before the farms had started producing, after which have to depend on farm production for their incomes. They considered themselves as government employees and felt they had the right to enjoy all the privileges and allowances given to official government employees. Not only this, but some farmers requested vacations to be spent outside of their farms or even abroad.

In other words the proposed labour force requirements for each farm type were vastly miscalculated due to errors by the planners. An intensive field survey should have been carried out in the areas under consideration in order to find out the exact requirements of labour for each farm type per year.

Such a study might also reveal the necessity for reevaluating and redesigning the farm sizes and the cropping patterns to correspond to the size and type of farming farmers could manage. If, However, the agricultural development planning will be resumed in the near future.

7. Population and Farm Distribution

Population studies were conducted in the project areas during the social and economic surveys carried out in 1973 and 1974. These two surveys were carried out

mainly for the purpose of selecting new farmers to be resettled in the project farm units.

The procedures for the selection of the farmers were written according to the regulations set out in Law No. 123/1971. According to this law, every farmer chosen as a beneficiary should meet the following specifications:

A. The must be a Libyan citizen.

B. The must be a farmer and able to practice farming.

C. The should not own any property on which he can already live a decent life.

D. For those who met the aforementioned specifications, the priority in selection should be given to those who have more dependents and less wealth.

E. Each new settler selected must prove, by a date not exceeding two years from the date of the delivery of the farm, that he has become literate erased, and that he has volunteered for the Civil Defense Services.

The surveys also revealed that the number of families in the households was always greater than the number of households. The ratio of families to households was 1:13.1.

In formation concerning gender and age was not available, since the 20,000 files of the interviewed farmers had by March 1985, still not been analysed further. The social work personnel were so busy with clerical work and solving the daily problems of the farmers that they were not able to analyse the data.

According to the results from the questionnaires of March 1984, the total number of farmers on the 2366 farms surveyed was 1727 person with an average family size of 7.3 persons (54% of the total number being males and 46% females).

Forty-nine per cent of the farm populations were less than 15 years of age, and 38% were between 15–60 years old. This latter group was considered of working age at 49% were under 15 years of age was considered a good sign for the future farm labour force. By the time these youths were adult, they would be most needed for the extra work which would be required when the farms reached their maximum development and the agricultural products reached their optimum yield.

8. Agricultural Education

One of the main objectives of the project's educational programmes was to train the farmers in the operation and maintenance of agricultural machinery and equipments, beekeeping and honey processing operations, and tackling the farmers' illiteracy. Evening classes were arranged for at least two years.

Consequently, most of the settlement projects established educational centres for farmers and their families.

The first centre for rural development was established in the Wadi Ar-Raml project in 1974.

The training of women was somewhat different from that of the farmers, concentrating more on vocational courses.

The main subjects in which the trainees were trained were as follows:

- A. Cutting and sawing.
- B. Knitting and arts.
- C. Wool work.
- D. Home economics.
- E. Health and social guidance.
- F. Adult teaching and religious guidance.

As a consequence of the increasing numbers of trainees at the centre, more courses were offered and several groups of trainees were established.

The amended subjects at the centre were as follows:

1. Adult teaching.
2. Religious guidance.
3. Cutting and sawing.
4. Home economics.
5. Handi crafts.
6. Wool works.
7. Health guidance.
8. Social guidance.
9. Beekeeping.

However, beekeeping and honey processing was the most beneficial subject to women trainees after 1976.

According to the educational standards of the trainees, they were classified into three groups:

- a. Elementary Certificate group.
- b. Less than sixth-grade group.
- c. Illiterate group.

In order to encourage the women and girls of the project families to attend the training courses, the Council for Agricultural Development created certain incentives. These were:

- i. To provide free transportation to and from the centre.
- ii. To secure free medical care and treatment.
- iii. To study and solve the social problems of the trainees, if there were any.
- iv. To grant a monthly allowance of LD 20 for women and LD 10 for girls.
- v. To provide valuable prizes at the end of each course.
- vi. To provide a nursery school for the children of the trainees while they were at the centre.

It was hoped that by the end of the five-year Transformation Plan 1976-80 all the girls and women in the project areas would be trained in most of the vocational subjects, and especially home economics, wool work, cutting and knitting, beehive keeping and honey processing.

However, by March 1985, the target of training all the women in the projects had not been fulfilled. This was due mainly to the fact that for one reason or another many farmers did not allow their wives and daughters to join the training centres.

By the end of 1985, the number of females trained in vocational education reached about 915 female, out of the plan target of about 1173 female.

The number of male trainees had reached about 2582 farmers in 1985, while the target plan was designated at about 2999 farmers (See Table B.4).

**Table B.4: Number of Male and Female Trainees In Agricultural Settlement
Projects in 1985**

Name of project	Male		Female	
	Designated	Fulfilled	Designated	Fulfilled
Al Garabulli	1200	1055	358	300
Wadi Ar-Raml	50	50	15	15
Wadi Al Hirah	500	3.50	200	150
Wadi Al Mjinin	120	1.20	* -	* -
Bir Tirfas	711	6.79	300	250
Wadi Al Haye	418	328	300	200
Total	2999	2582	1173	915

* Here there was no educational centre for women.

9. The Economic Conditions of the farmers

The initial economic conditions of the farmers in the projects are not known. All farms depended on the government monthly allowances if between LD 70 to LD 170 depending on the farmer’s former job. However, if a new farmer had no any official job prior to his engagement in the project, he was granted the minimum labour wage of LD 70 per month for three consecutive years.

According to the questionnaires and field investigations in 1980 the annual net income, ranged between LD 3500–10500, depending on farm size, cadastral class, irrigation water and the following of modern and scientific techniques and agricultural practices.

The average net income of the first year's production was between LD 345 and LD 576 in almost all projects. In 1985 net incomes from farm production were between LD 1020 and LD 2051.

After 20 years, of hard work, the net incomes for farmers on the projects ranged between LD 2573 and LD 3500 for the last year (1996).

These figures were calculated according to the following formula:

$$C_i = G_i - p_e \text{ \& } N_i = C_i - Le,$$

where: -

N_i = net income.

G_i = gross income.

C_i = cadastral income.

Le = living expenses of the farmer's family.

p_e = production ex pensés.

10. The Attitudes of Farmers

The feelings of the farmers were very positive, particularly after they had received their new farms and monthly allowances, free equipment and machinery services. However they also felt insecure. Because they believed that they were government

employees, hence some farmers in the projects sometimes used to leave their farms secretly work with their private cars as hired drivers, and leaving their wives and children to work on the farms.

Most of the new settlers thought that they were doing the government a favour by accepting the farms. Thus, they considered themselves as government employees, rather than farmers. Consequently, when any problems arose, they would rush to the project administration asking for help or advice. As mentioned earlier, some farmers even asked to be granted vacations to spend outside their farms.

Therefore, instead of being the project planning and development centre, the administrative headquarters functioned more as a bureau of social work, social welfare and unemployment. Nonetheless, the above-mentioned attitudes tended to be expressed less frequently over the eleven years of agricultural practice between 1974-1985.

Finally, it should be stressed that the great achievements of the agricultural land settlement projects, despite all their local and adverse circumstances, must be considered a magnificent success for the first of September revolution, as well as for the men who created and supervised them. These projects were anticipated, however, to be strong contributors to national economic and social advancement, which Libya has been striving thriving very hard to accomplish in a very short period of time.

APPENDIX C: **QUESTIONNAIRE**

A: Farm Specific Questions

1. Farm’s Location/Number
(
)
2. Total size of the farm in hectares
(
)
3. Total exploited area in hectares
(
)
4. Exploited area by ‘dry’ agriculture in hectares
(
)

5. Which method of irrigation used?

- A- Spraying
(
)
- B- Dripping
(
)
- C- Flooding
(
)

6. Sources of irrigation?

- A-Wells
(
)
- B-Dams
(
)
- C-Others
(
)

7. Type of soil?

- A-Sandy
(
)
- B-Clay
(
)
- C-Sandy-clay
(
)
- D-Others
(
)

8. Soil fertility?

- A-Good
(
)
- B-Average
(
)
- C-Poor
(
)

9. If involved in fruit production, please fill in the following table

TREES	AREA	NUMBER	ANNUAL PRODUCTION	TOTAL COSTS	TOTAL REVENUE
GRAPES					
FIGS					

PALMS					
PLUMS					
APPLES					
ALMONDS					
OLIVE					
Others					
TOTAL					

10. If involved in crops/vegetables production, please fill in the following table

CROP	AREA	ANNUAL OUTPUT	TOTAL COSTS	TOTAL REVENUE
FORAGE				
WHEAT				
BARLEY				
TOMATOES				
POTATOES				
PEPPERS				
TOTAL				

11. If involved in animal husbandry or meat/dairy production, please fill in the following table.

ANIMAL	NUMBER	TOTAL COSTS	ANNUAL REVENUE
SHEEP			
GOATS			
CAMELS			

POULTRY			
COWS			
TOTAL			

12. Do you use fertilizers in farming?

- A- Always

()
- B- Sometimes

()
- C- Never

()

13. How readily available are the following resources? [1-5; 1=poor , 5=excellent]

- A- Water

()
- B- Fertilizers

()
- C- Seeds

()
- D- Insecticides

()
- E- Medicines

()
- F- Forage

()
- G- Training

()

14. Where do you acquire your inputs from?

- A- Cooperatives

()
- B- Market place

()
- C- Other sources

()

15. How often does the agricultural inspector visit your farm??

- A- Weekly

()
- B- Monthly

()
- C- Quarterly

()
- D- Annually

()
- E- Never

()

16. Please fill in the following table if you use any tools/machinery for agriculture.

TYPE	NUMBER	VALUE	Tick if owned by the farm	FREQUENCY	
				DAILY	WEEKLY
TRACTOR					
CAR					
WATER PUMP					
TUBES					

SOWING MACHINE					
HARVEST MACHINE					
TRAILER					
FORAGE PRESS					
LORRY					
TOTAL					

17. Where do you sell your products?

- A- At the farm

()
- B- At the local market

()
- C- To the cooperatives

()
- D- Others

()

18. How do you transport your farm’s products?

- A- By own private vehicle

()
- B- By a cooperative’s vehicle

()
- C- Others

()

19. Who sets up prices of your products?

- A- Market

()
- B- Yourself

()
- C- The cooperatives

()
- D- The government

()
- E- Others

()

20. Please report your last year’s output and revenues

PRODUCT	QUANTITIES	UNIT PRICE (AVERAGE)	Total Revenue
Fruits			
Crops			
Dairy			
Meat			
Poultry			
Others			

B: Farmer Specific Questions

21. How long have you been working in this farm? ()

22. What were you doing before moving to this farm?

- A- Farming ()
- B- Animal Husbandry ()
- C- Both A and B ()
- D- Others ()

23. Years of experience in agriculture-related activities? ()

24. Do you live in the farm?

- A- Yes ()
- B- No ()

25. How comfortable/adequate are the following facilities/services? [1-5; 1=poor, 5=excellent]

- A- Accommodation ()
- B- Access to drinking water ()
- C- Access to electricity ()
- D- Access to hospital/clinic ()
- E- Access to schools/colleges ()

26. How many hours per week of any paid job outside the farm? ()

27. Please fill in the following table giving information about yourself and any person living with you or working in the farm.

PERSON	AGE	Education Qual. (Primary, Secondary, College, etc.)	Weekly Working Hours in the farm
Yourself			
Your Wife			
<u>Your Sons/Daughters:</u>			
<u>Farming Workers:</u>			

28. Does your family’s annual income cover all expenses?

- A- YES ()
- B- NO ()

29. What are your family’s previous year income and expenditure?

- A- Income ()
- B- Expenditure ()

30. What would your son/daughter like to do in the future?

- A- Farming ()
- B- Office work ()
- C- Further studies ()
- D- Industrial work ()
- E- Others ()

31. Considering all the costs and benefits derived from your job, how would you rank your general feeling about the project? [1-5; 1=extremely unhappy, 5=extremely happy] ()

32. In the following table please list what you regard as the main problems you have faced or are facing in your activity. Please also list any possible solutions, which you believe would help eliminate these problems.

PROBLEMS	POSSIBLE SOLUTIONS

Thank you for your time and effort in completing the questionnaire. May I once again assure you that all this information will be treated with strict confidentiality and will not, under any circumstances, be released to a third party.